Rollin K. Daniel
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Rhinoplasty

An Anatomical and Clinical Atlas

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ISBN 978-3-319-67313-4 ISBN 978-3-319-67314-1 (eBook)
https://doi.org/10.1007/978-3-319-67314-1

Library of Congress Control Number: 2018935421

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

A Rhinoplasty Revolution has begun, which will dramatically alter how we perform the operation. It is comparable in its impact to the changes that occurred following widespread adoption of the open approach. Rather than being based on visualization, the current revolution is driven by new anatomical insights. One example is the concept of the "bony cap," which has repudiated the decades-old belief of a distinct bony hump that required en bloc removal. In contrast, we can easily rasp off the bony cap and then modify the underlying cartilage vault directly. The revolution extends to tip surgery, where we now analyze and surgically manipulate the soft tissue facets as well as the cephalic-caudal border relationship of the lateral crus.

Because limited exposure has often caused rhinoplasty surgery to be shrouded in mystery, an anatomical atlas is a necessity. We have decided to emphasize each anatomical area and the associated surgical techniques in both cadavers and clinical material, followed by clinical case studies. Chapter 1 emphasizes the five-layer composition of the soft tissue envelope using both serial cadaver dissections and sonogram studies. Three different dissection planes are illustrated, followed by detailed demonstration of nine nasal ligaments. Clinical cases illustrate how to manage cases with both thick skin and thin skin.

Chapter 2 details the "three-crus" concept of the alar cartilages and the direct linkage between surface aesthetics and the underlying anatomy. The medial crus, with its footplate and columellar segment, represents the pedestal of the tip complex. Appropriately, tip suturing is emphasized for the middle crus, with ten different sutures shown in depth. The concept of "intrinsic tip projection" as it relates to the middle crus is shown convincingly. The lateral crus, with its associated alar ring, is discussed as it relates to alar malposition and a range of turn-under or turn-over flaps. All of these findings are illustrated in a clinical case where a major tip change is achieved simply by repositioning and supporting the displaced alar cartilages.

Chapter 3 is an "exposed" look at the osseocartilaginous vault, which is minimally visualized in a routine rhinoplasty. Currently, surgeons see the tip cartilages far more than the dorsum, which may explain why dorsal deformities are now the tell-tale sign of a previous rhinoplasty. The new concept of a "bony cap" shifts the operation away from a destructive "bony hump reduction" to more of a modification of the underlying cartilaginous vault. Cadaver dissection allows one to see for the first time the true location of the various osteotomies. Implementation of piezoelectric instrumentation has lowered the location of the lateral osteotomies to the nasofacial groove and reintroduced complete osteotomies, albeit with maintenance of periosteal and mucosal support.

Chapter 4 deals with the septum and valves, while emphasizing both anatomical chokepoints and dynamic collapse at multiple points. A range of septal surgery is demonstrated clearly in cadavers, as it is rarely seen clinically owing to limited visualization. These techniques range from caudal relocation to repair of dorsal disjunction to subtotal and total septoplasties where rigid fixation is critical. Five different valvular checkpoints are illustrated, including both their pathology and their clinical treatment. Ultimately, the concept of an "integrated valvular collapse" is introduced, which begins at the internal valve angle and progresses to the lateral wall before collapsing the external valve.

Chapter 5 on the nasal base demonstrates clearly why cadaver dissections are so important for rhinoplasty surgeons. Simply put, the nasal base has never been seen before in this detail. New insight is provided into the columellar base, the soft tissue facets, the tela subcutanea cutis, and the alar rim. Instead of an obligatory filler chapter, one has the opportunity to understand all seven areas of the nasal base, from their anatomy to surgical procedures.

Chapter 6 details how to harvest the various graft materials (septum, concha, rib, dermis) and convert them to surgical grafts. Obviously, the number of grafts is unlimited, but all of the most common ones are illustrated. Caudal and septal extension grafts are discussed in detail, as is the role of fascia. The use of massive composite grafts from the concha will be new for many readers, along with the use of diced cartilage for peripyriform augmentation. The role of rib grafts is reviewed from composite reconstruction to structural reconstruction for the destroyed nose.

Chapter 7 is offered as a foundation operation for the beginning surgeon. It is not presented as the definitive answer or the perfect procedure, but rather as a starting point for those learning the operation. Based on training a large number of residents and fellows and receiving their follow-up comments once in practice, the senior author (RKD) knows that this foundation will lead to a “good” result in the average nose. The more complex the problem, the more often one must modify the basic technique, but the surgeon must start somewhere, and this operation will minimize complications. The validity of this operation is confirmed by the junior author (PP), whose first surgical procedure as an intern was not excision of a lipoma, but rather a rhinoplasty.

A few words on how this book was assembled. It is truly an atlas, with emphasis on visual learning. The anatomical photographs are extraordinary and every step has been taken to maximize their clarity. The text was written to fit the illustrations rather than the other way around. We do not cite every reference in an academic fashion, but rather have elected to go with longer “reading lists” and to reference authors in the text by last name and date of publication. The format is similar to that of *Mastering Rhinoplasty*.

In closing, there are numerous people we need to thank for their assistance over the past 3 years. The junior author would like to express his gratitude to his mentor Dr. Lajos Patonay. All of the dissections were done in his laboratory at the Anatomy Institute, Semmelweis University, Budapest. He provided an opportunity to join the team as a medical student and gave access to the laboratory and research facilities. Without his support, it would not have been possible to create this atlas. Sincere thanks also go to Dr. Gyongyver Molnar, Dr. Tamas Karasz, Istvan Kristof, and Lajos Herczeg.

The senior author wishes to thank his office staff, especially Judy An, who cajoled the patients to return for their follow-up exams and photographs. All of the clinical cases were done at Newport Beach Surgery Center, whose entire staff, from Front Desk to Postoperative Care, are true professionals dedicated to the highest in patient care. In the Operating Room, thanks go to the “Four Graces” (Breanna Green, Jhaave Reyes, Windy Bess, and Petra Wirsching), who made sure the blue towels were correct and no blood was visible in the endless series of photographs.

Ultimately, this atlas is our gift to the rhinoplasty community, with the hope that surgeons will see more clearly the linkage between nasal anatomy and rhinoplasty, for the benefit of their patients.

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Contents

INTRODUCTION

1

Surface Aesthetics and Soft Tissue Envelope

Why is the soft tissue envelope (STE) so important in the planning and execution of a rhinoplasty operation? Put simply, the nasal skin envelope covers the underlying osseocartilaginous structures, preventing the surgeon from seeing the true nasal deformity preoperatively and often limiting or compromising the postoperative result. Most surgeons consider skin redraping and remodeling to be the greatest uncertainty in the healing process. The essential purpose of this chapter is to teach the reader how to "see through" the skin and understand the underlying tip and dorsal anatomy.

Intraoperatively, three different dissection planes are demonstrated for treating patients with thin, normal, or thick skin. In most cases, a dissection in the avascular deep areolar plane below the superficial musculoaponeurotic system (SMAS) is preferred. In a thick-skin STE, the initial dissection is done in the superficial areolar sub-dermal plane followed by a sub-SMAS dissection with removal of the intervening soft tissue. In thin-skin cases, the dissection plane is in the subperichondrial and subperiosteal plane. Postoperatively, sequential sonograms allow the surgeon to evaluate the healing process and guide the decision to utilize triamcinolone acetonide (Kenalog®) for excessive scar tissue or isotretinoin(Accutane®) for dermal thickening. Ultimately, we are now able to make major changes in nasal shape without being limited by a noncompliant skin sleeve.

SURFACE LANDMARKS

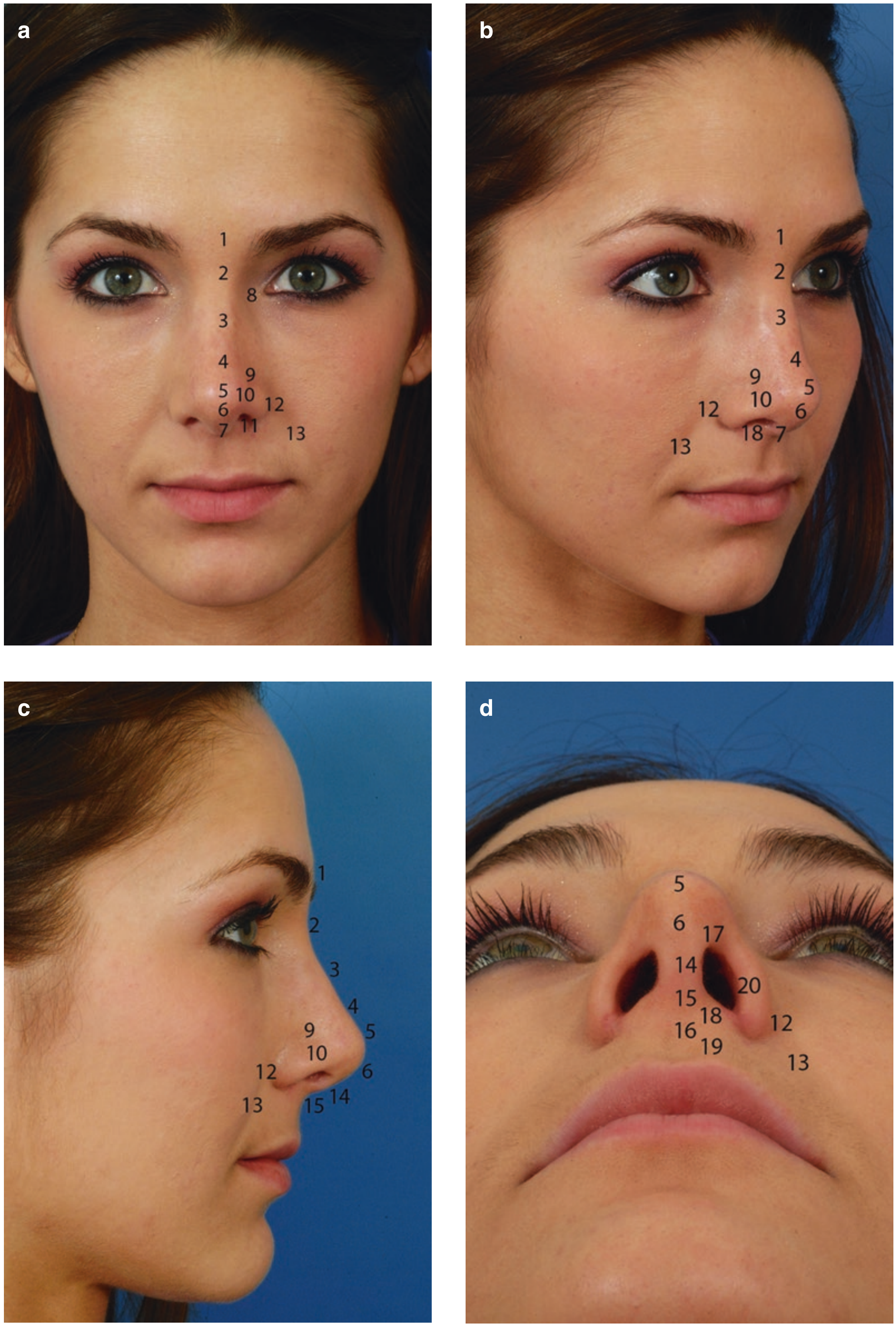


Fig. 1.1 (**a–d**) Surface landmarks

Figure 1.1 illustrates the surface landmarks of the nose: (1) glabella, (2) nasion, (3) rhinion (keystone point), (4) supratip, (5) tip, (6) infratip lobule, (7) columella, (8) medial canthal ligament, (9) supraalar groove, (10) alar groove, (11) nostril, (12) alar crease, (13) nasolabial fold, (14) columellar pillar, (15) columellar base, (16) philtrum, (17) soft tissue facet (triangle), (18) nostril sill, (19) philtral crease, (20) alar sidewall.

TOPOGRAPHIC LANDMARKS

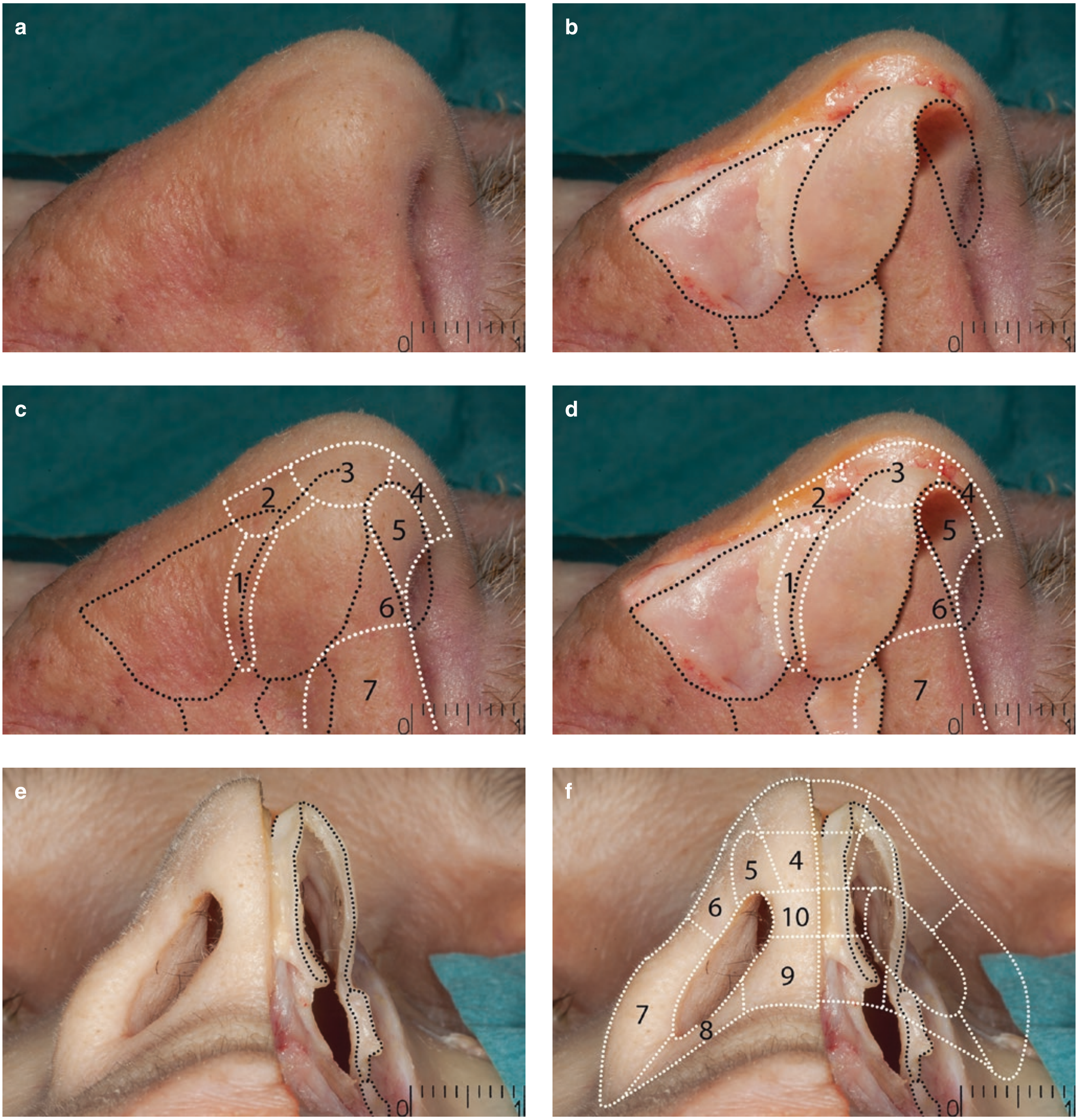


Fig. 1.2 (**a–f**) Topographic landmarks. Note: all photographs are taken with a fixed position camera allowing exact overlays.

Figure 1.2 demonstrates topographic landmarks and areas: (1) scroll area, (2) supratip, (3) tip, (4) infralobular triangle, (5) soft tissue facet, (6) nostril rim, (7) alar lobule, (8) nostril sill, (9) columellar base, (10) columellar pillar.

ANATOMICAL LAYERS

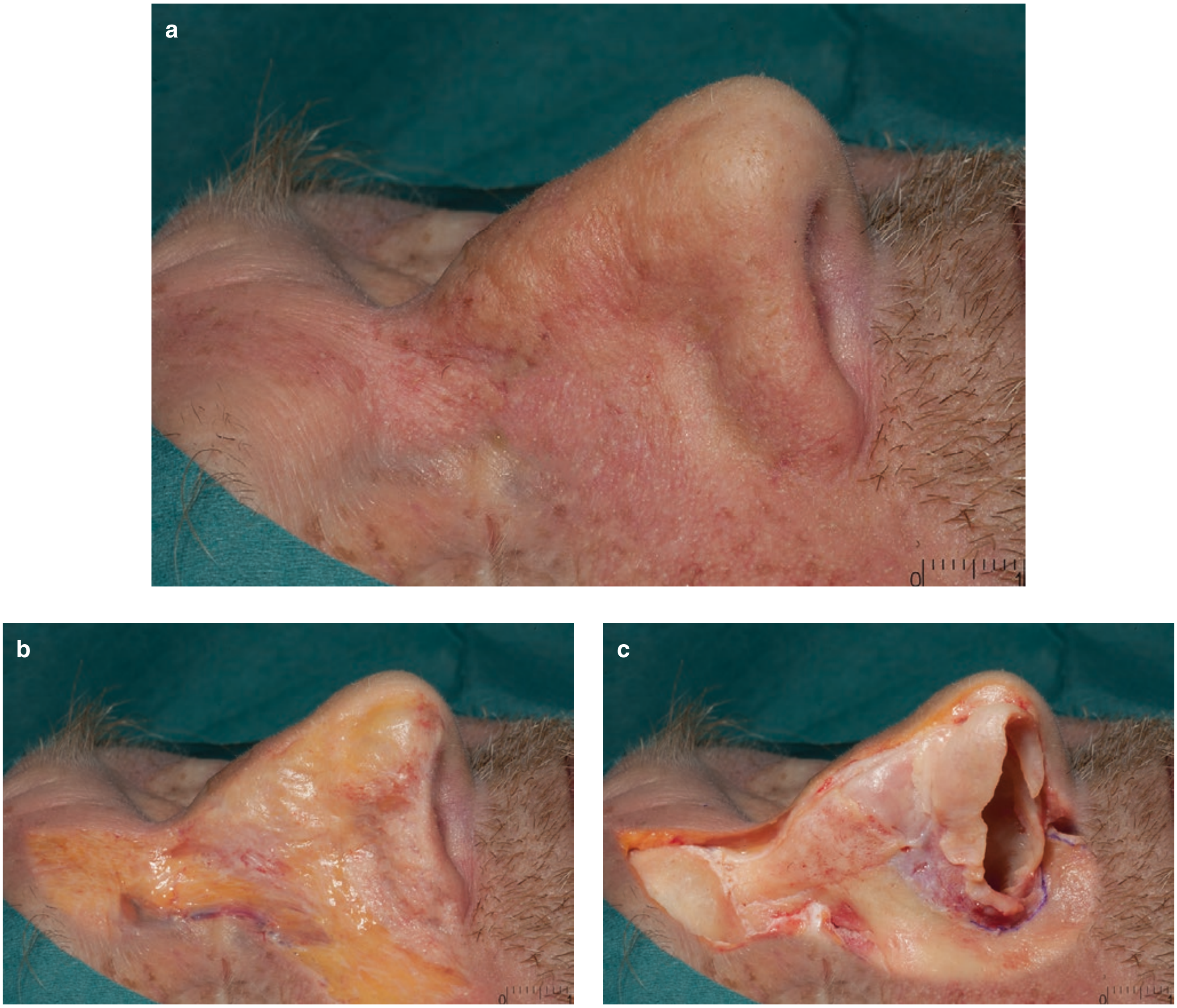


Fig. 1.3 The soft tissue envelope of the nose: (**a**) Skin. (**b**) Subcutaneous fat and superficial musculoaponeurotic system (SMAS). (**c**) Osseocartilaginous skeleton underlying the soft tissue envelope. Note: all photographs are taken with a fixed position camera which records accurate sequential dissection.

Surgeons must develop the ability to "see through" the mask of the skin envelope and visualize the underlying osseo-cartilaginous foundation of the nose. Figure 1.3 was created with a "fixed position" camera, which allowed an exact sequential delayering of the nose. The STE is composed of the epidermis, dermis, subcutaneous fat, and the superficial musculoaponeurotic system (SMAS), which varies dramatically in component thickness from cephalic to caudal in the same individual, and even more dramatically between patients. The skin itself can be divided into a thin upper half and a thicker lower, sebaceous half. In many ethnic noses, the surgeon is challenged to visually *integrate* the two parts of the skin envelope, often with solid dorsal cartilage grafts. The subcutaneous fat is localized in the supratip area, the radix, and the lateral nasal wall. If one thinks of *layers* as opposed to *planes,* there are five layers: (1) skin, (2) superficial areolar layer, (3) SMAS, (4) deep areolar layer, and (5) perichondrium-periosteum.

ANATOMICAL LAYERS

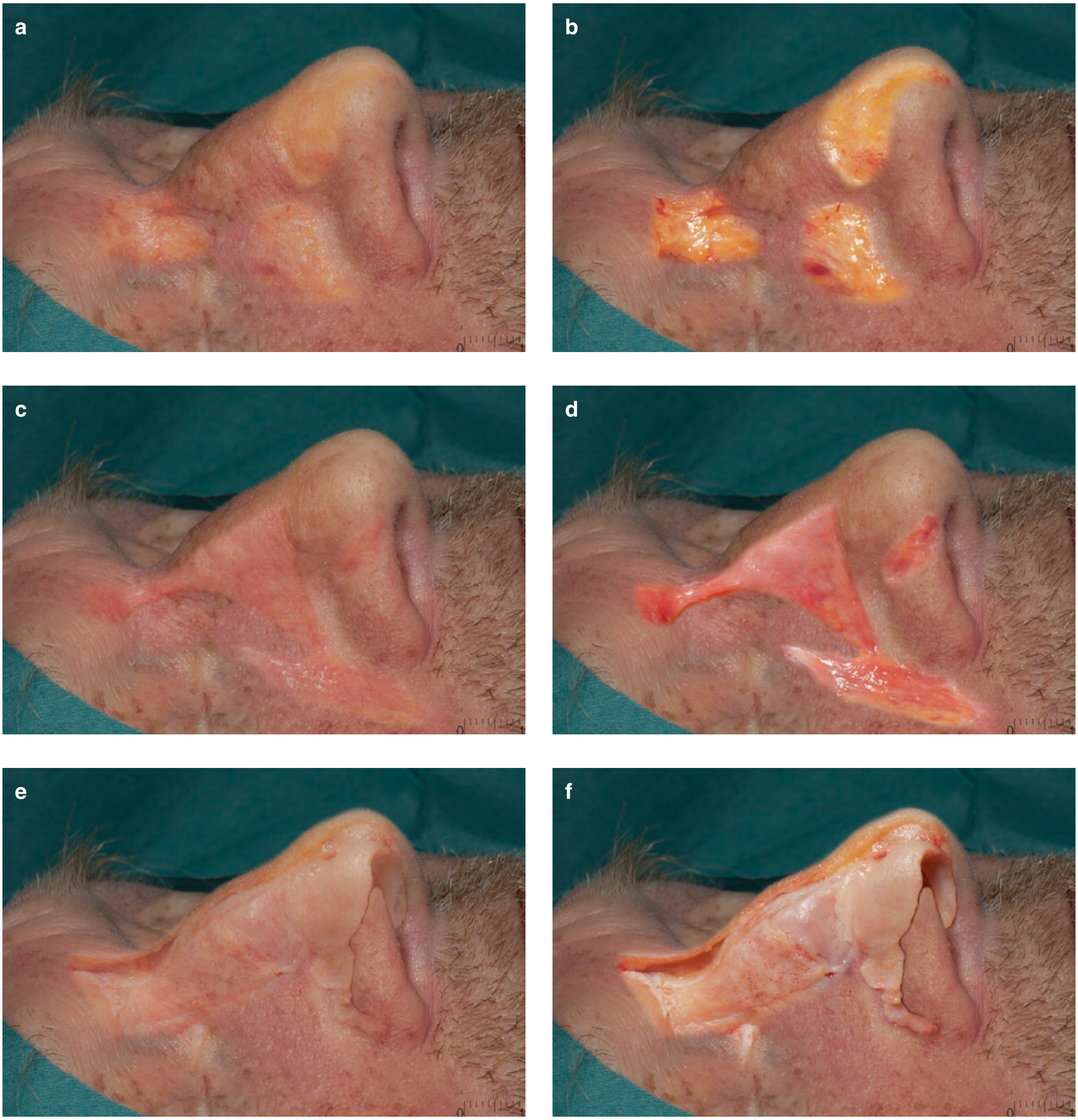


Fig. 1.4 (**a**, **b**) Subcutaneous fat pads. (**c**, **d**) Muscles. (**e**, **f**) Osseocartilaginous skeleton of the nose

The two areolar layers become relatively avascular *dissection planes*. The nasal SMAS integrates and transmits the contraction forces of the nasal musculature (Fig. 1.4). Preservation of the SMAS is desirable from a functional perspective and in maintaining adequate long-term padding of the skin. Recently, surgeons have begun to dissect in a subperichondrial-subperiosteal plane that maintains the integrity of the STE and reduces damage to the neurovascular structures (Çakir et al. 2012).

SURFACE AESTHETICS

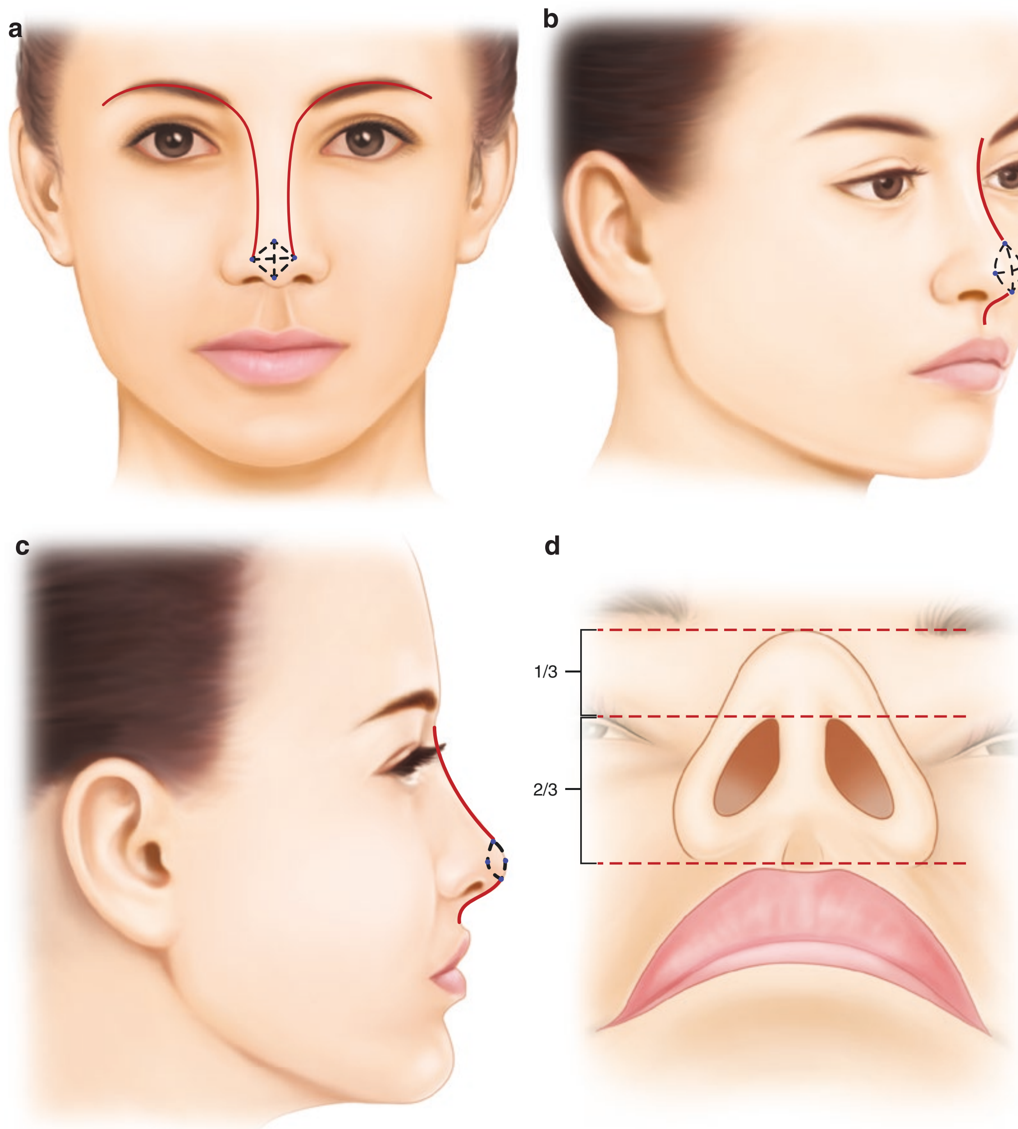


Fig. 1.5 (**a–d**) Surface aesthetics according to Sheen (1978)

Until publication of *Aesthetic Rhinoplasty* in 1978 by Jack Sheen (Sheen 1978), surgeons analyzed the nose in almost an architectural manner using angles, lines, planes, and profilometers (Fig. 1.5). Sheen's emphasis on aesthetics revolutionized preoperative analysis and postoperative evaluation, especially as regards tip surgery. On front view, he emphasized the divergent concave dorsal lines that connect the superciliary ridge of the orbit through the radix to the tip. He visualized the tip as two equilateral geodesic triangles with a common base, the length being the intercrural distance. The apex of the superior triangle is the point of tip differentiation, and the apex of the inferior triangle is the point of columellar lobular junction. Interestingly, the apogee of the intercrural line should be the highest point of the tip.

SURFACE AESTHETICS

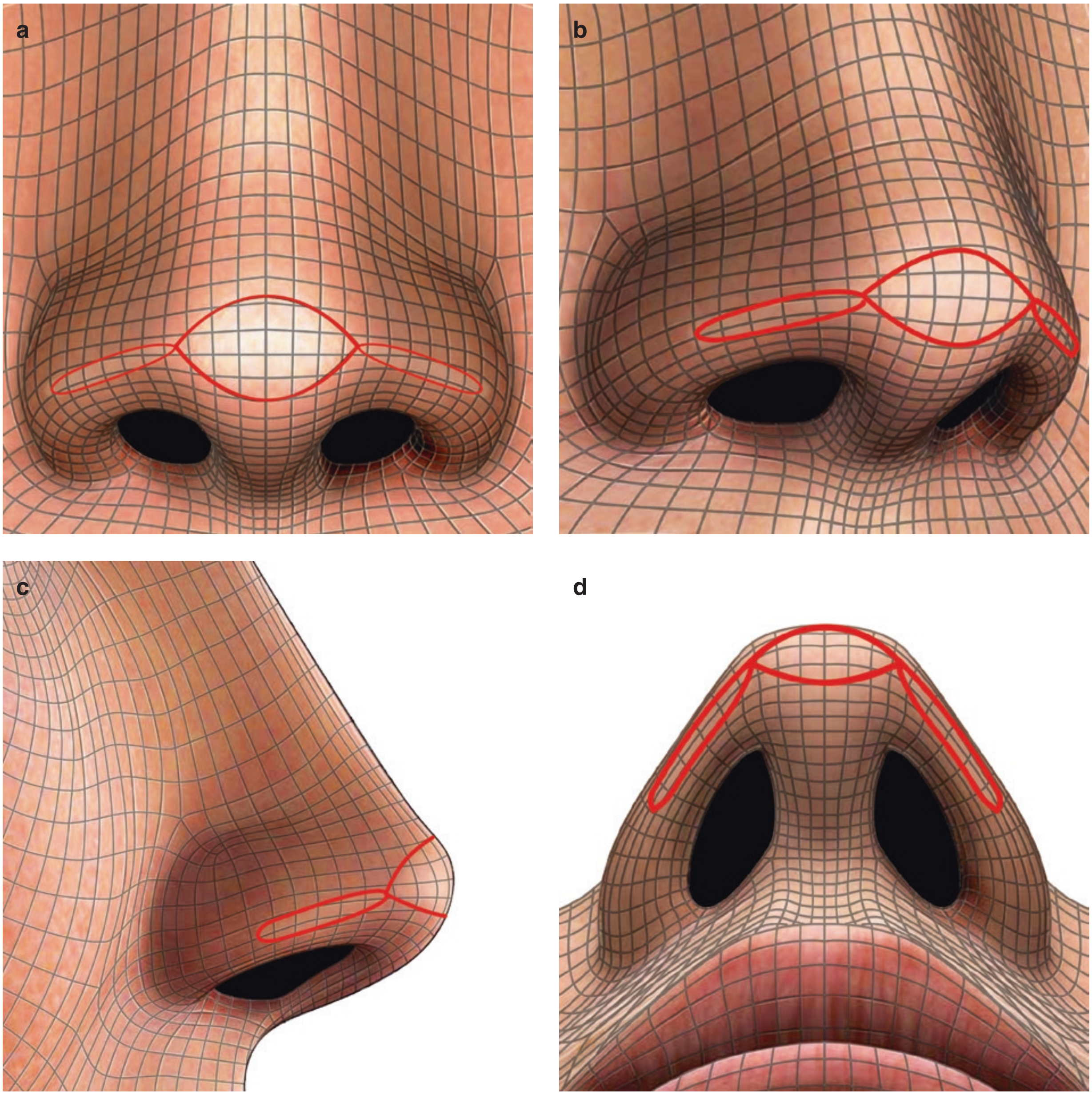


Fig. 1.6 (**a**–**d**) Surface aesthetics according to Toriumi (2006)

Toriumi (2006) introduced the concept of *nasal tip contour* as a series of surface *highlights and shadows* created by underlying anatomical high points and low points (Fig. 1.6). Specifically, the tip is represented by a horizontal tip *highlight* corresponding to the domes, with continuation of the highlight as an elevated ridge in continuity with the alar lobule. Surgically, this tip highlight can be created with a domal onlay graft, while the elevated ridge along the alar margin will be accentuated by an alar rim graft. Equally important, a *shadow* in the supratip region continues laterally into the alar groove, thus setting off the tip. Excision of cephalic crura emphasizes the supratip breakpoint and moves it caudally, setting off the tip. The linkage between surface aesthetics and surgical techniques is readily apparent in Toriumi's operative procedures.

POLYGONS

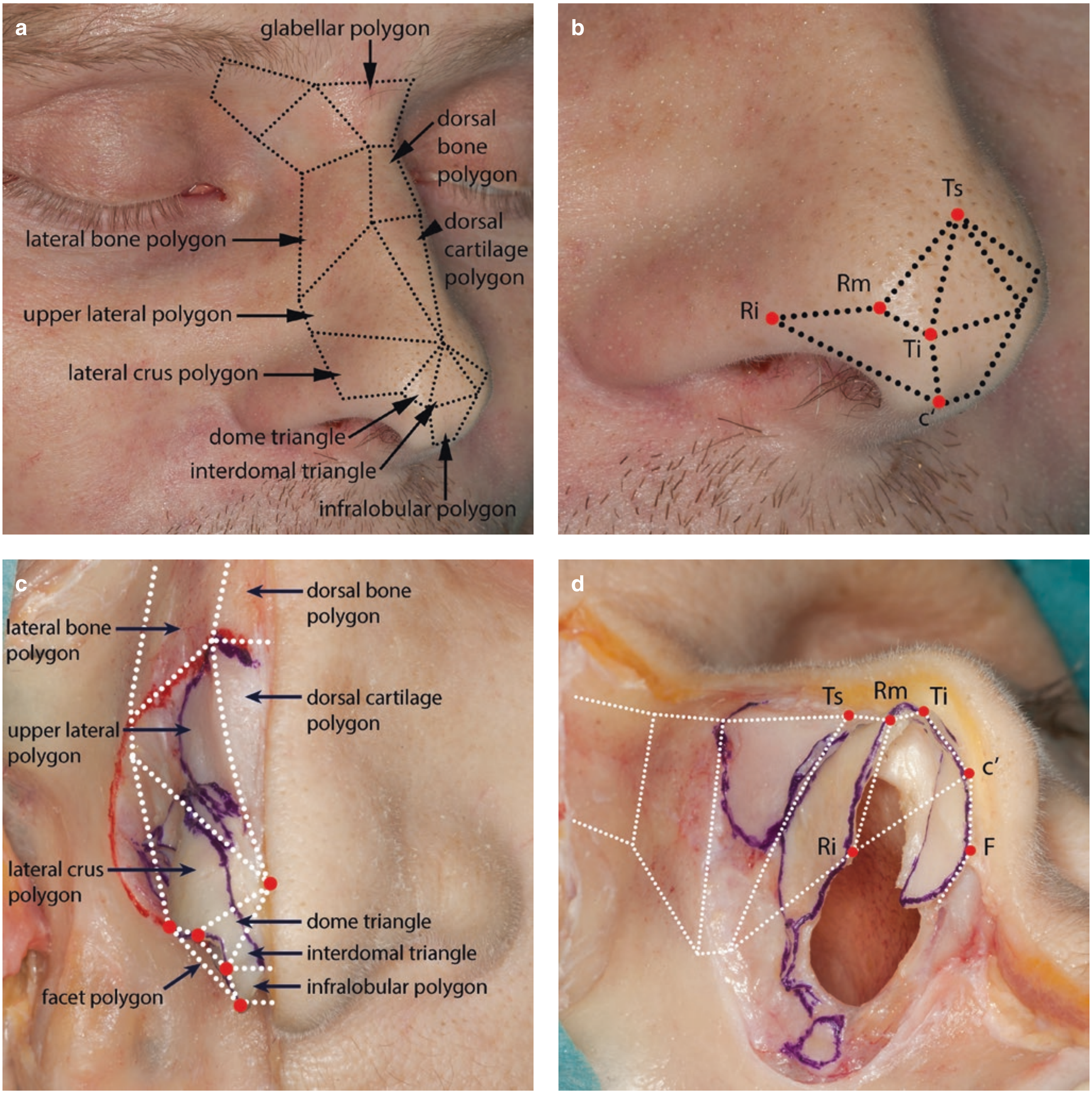


Fig. 1.7 Cakir's concept of the aesthetic nasalpolygons. (**a**, **b**) Surface polygons. (**c**, **d**) Points defining the polygons of the nasal tip

Çakir et al. (2012) and Çakir (2016) introduced the concept of *polygons* for analyzing the aesthetics of the nose, based on artistic principles from drawing and sculpture. Essentially, the nasal polygons are geometric forms derived from a composite of lines, shadows, and highlights, with specific proportions and breakpoints (Fig. 1.7). The osseocartilaginous vault is comprised of two bony polygons (dorsal and lateral) and two cartilaginous polygons (dorsal and lateral). Importantly, Çakir notes that the dorsal aesthetic lines are not straight, but rather "fusiform"—narrow in the radix, wider at the keystone, and narrow again at the supratip. On basilar view, one sees the infralobular, columellar, and footplate polygons.

POLYGONS

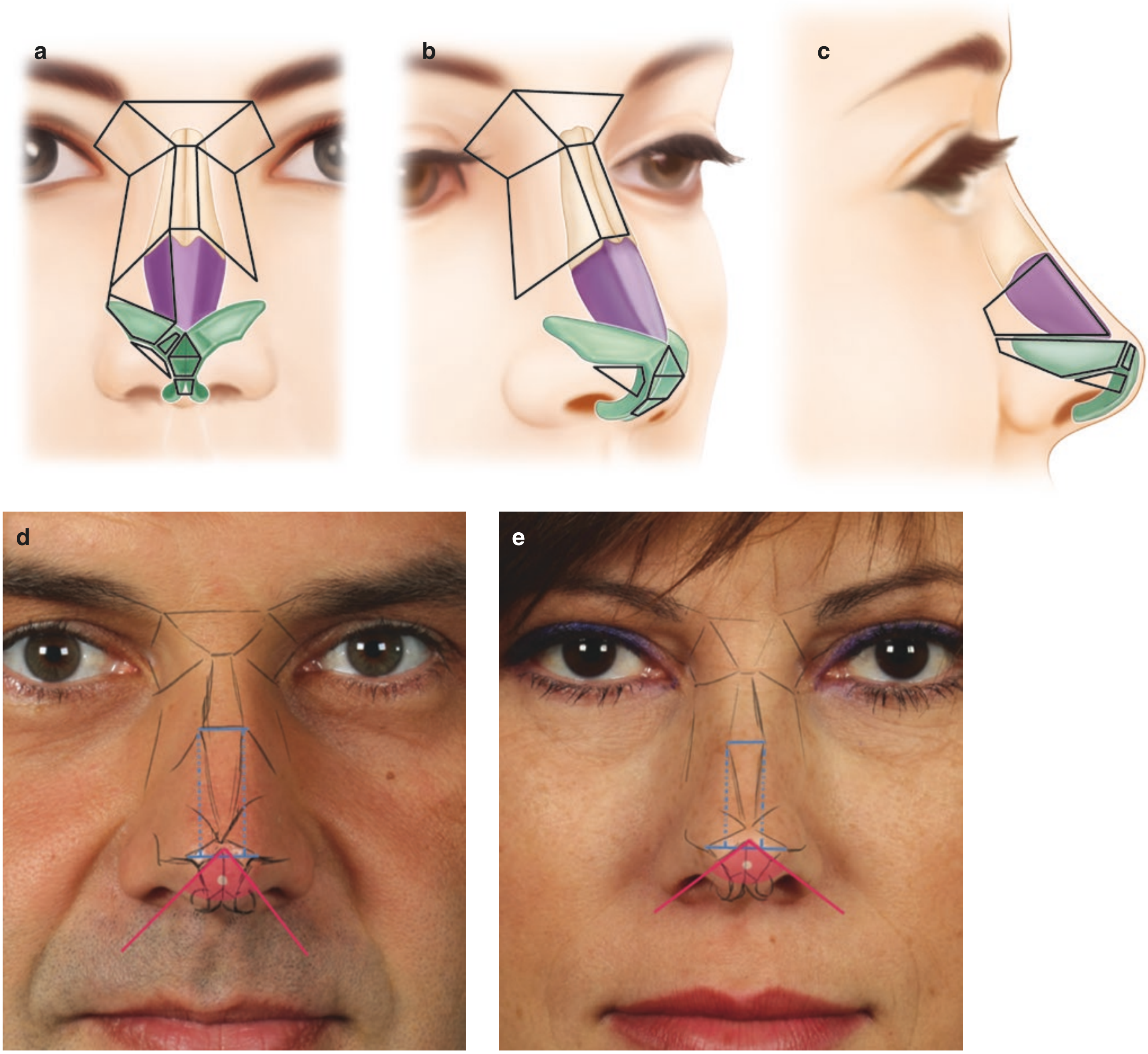


Fig. 1.8 Cakir's concept of the aesthetic nasalpolygons. (**a–c**) Polygons. (**d**, **e**) Variations in men and women

Çakir conceives of the nasal tip as being comprised of two mass polygons (dome triangles, lateral crus polygons) and two space polygons (interdomal triangle, facet polygons). The domal triangle is defined by three points (Ts, Ti, Rm); the interdomal triangle is defined by Ts superiorly and Ti on either side. Aesthetically, Ts is the superior tip point, Ti the inferior tip point, and Rm the medial rim point. Anatomically, Ti corresponds to the medial genu of the domal notch, and Rm to the lateral genu of the domal notch. The facet polygon is bordered by Ti to Rm at the top and C to Ri at the bottom (Fig. 1.7b). Anatomically, C corresponds to the columellar breakpoint (c′) and Ri to the turning point of the lateral crus. The lateral crus polygon is a mass polygon comprised of the body of the lateral crus. There are distinct variations in males and females (Fig. 1.8).

POLYGONS: CASE STUDY (*COURTESY OF* DR. BARIŞ ÇAKIR)

This case study shows that one can modify and surgically achieve the desired aesthetic polygons.

Analysis: A 23-year-old woman presented for rhinoplasty. She had a boxy tip, with the lateral crus too wide, long, and convex, plus a too obtuse resting angle. These deformities created the look of cephalic malposition. Patients with this deformity are at great risk for pinch nose, alar retractions, and nostril asymmetries because they generally need cephalic lateral crura resection more than 5 mm. Bulbous tips generally have excess at the caudal border of the lateral crura.

Operative Technique: This surgery used a closed technique with a 3-mm auto-rim flap. Pitanguy's dermocartilaginous ligament was preserved (Fig. 1.9). Figure 1.10 illustrates the changes.

1. Trans-septal transfixion incision with 1 mm of caudal septum left on the columellar side.
2. The nasal dorsum exposed in a subperichondrial and subperiosteal plane.
3. 2 mm caudal and 3 mm cephalic excision of the lateral crus.
4. 5 mm lateral crural steal on both sides.
5. 3 mm medial crural overlap, followed by insertion of a partial-length columellar strut.
6. The lateral crus resting angle was corrected using a cephalic dome suture.
7. The footplates were sutured to each other with 5/0 Prolene®.
8. Lateral ostectomy was used for closing the open roof. Libra grafts were placed.
9. The trans-septal transfixion incision was closed by suturing the two portions of the caudal septum together.
10. Vertical scroll ligament was repaired with 5/0 PDS® II and mucosa was closed with 6/0 Monocryl® sutures.

Commentary: An important aesthetic concept is the *resting angle* between the lateral crus and the upper lateral cartilage which should be 100°. Importantly, the caudal border of the lateral crus rises above the cephalic border and the facet polygon is opened. Treatment of the lateral crura caudal excess with auto-rim flap decrease alar rim retractions and nostril asymmetries.

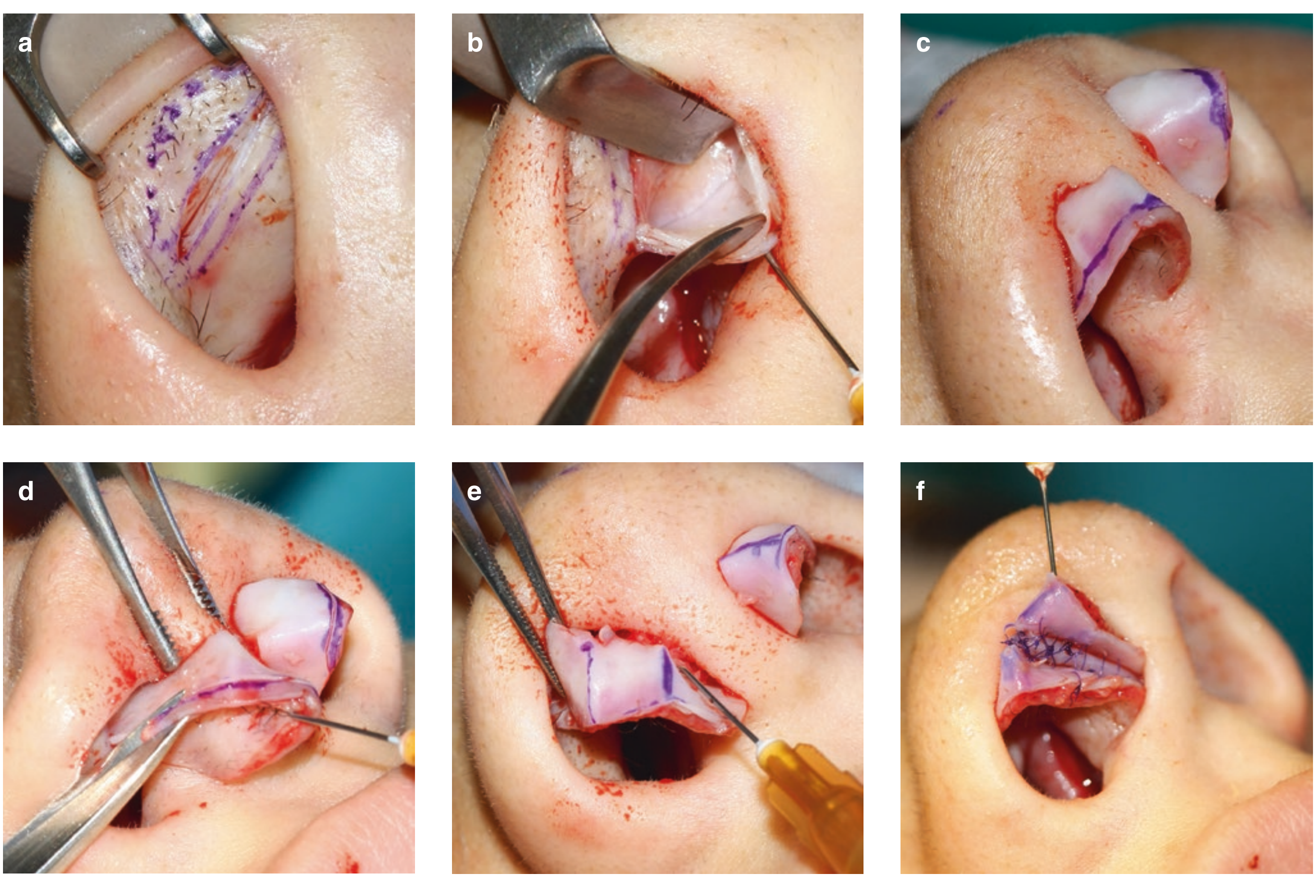


Fig. 1.9 (**a**) Transcartilaginous incision. (**b**, **c**) Subperichondrial dissection. (**d**) Caudal excision. (**e**, **f**) Medial crural overlap

POLYGONS: CASE STUDY (*COURTESY OF* DR. BARIŞ ÇAKIR)

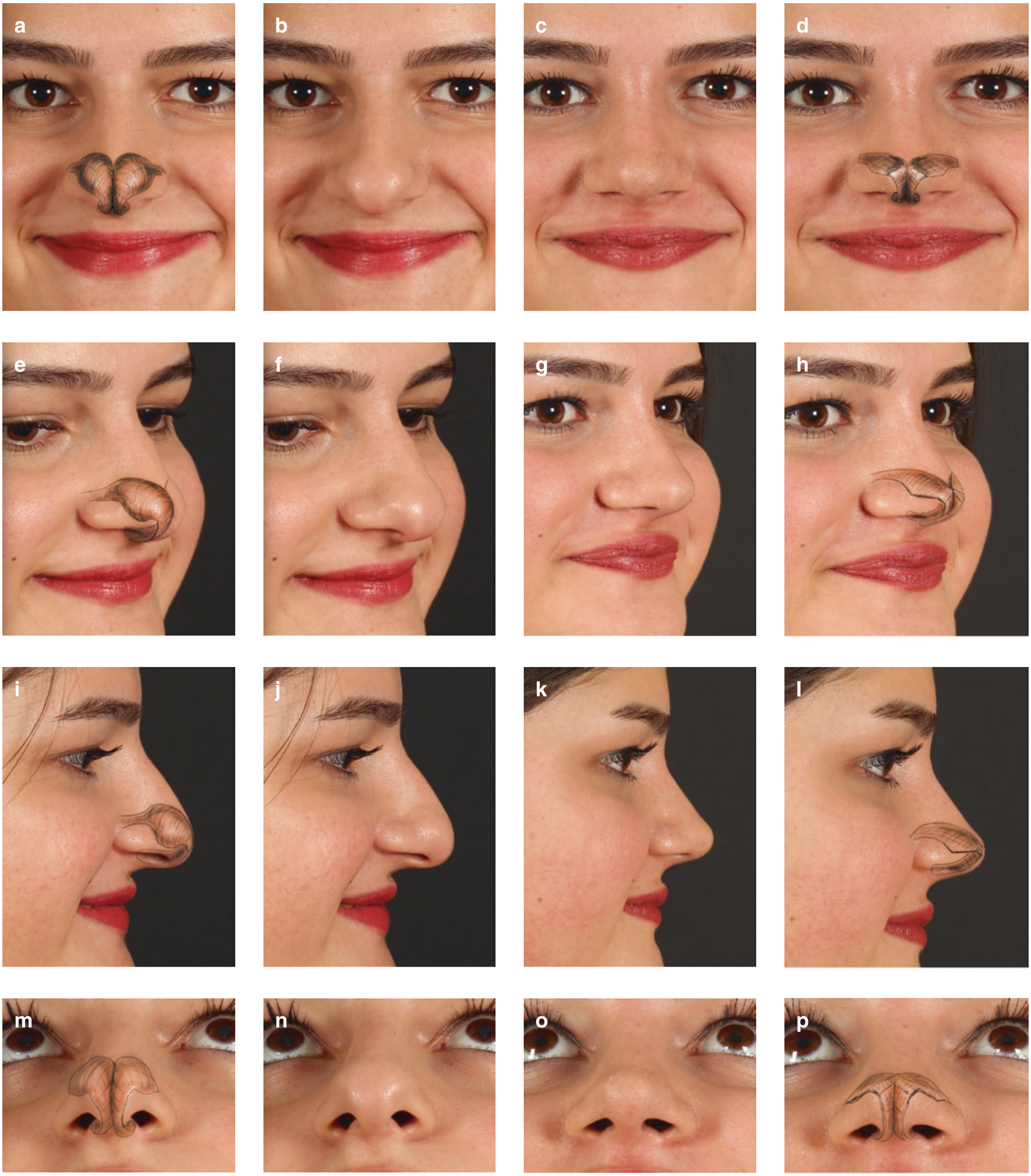


Fig. 1.10 (**a–p**) Case study patient before rhinoplasty (*left*) and 1 year after surgery (*right*)

SKIN THICKNESS AND LAYERS

Fig. 1.11 Skin thickness in the midline

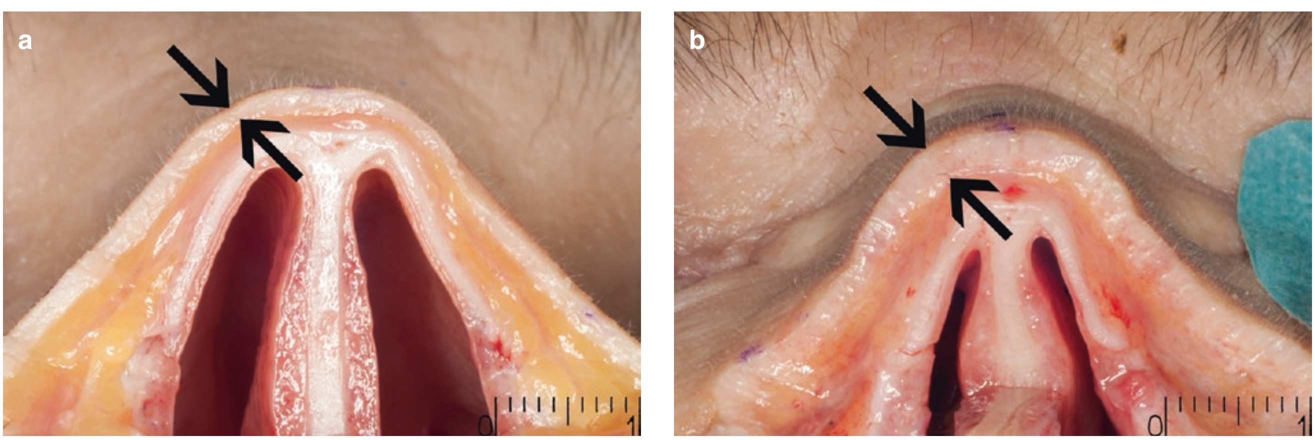


Fig. 1.12 Variations in dermal thickness in the middle third (same scale): (**a**) thin and (**b**) thick

The thickness and composition of the soft tissue envelope (STE) varies dramatically in different areas of the nose. In the midline, the STE is the thickest in the upper third, thinnest in the middle third, and highly variable in the lower third (Fig. 1.11). The thickness of the soft tissue is determined by the thickness of the dermis, subcutaneous fat, and SMAS (Figs. 1.12 and 1.13). The dermal thickness is very thin over the rhinion and very thick in the supratip area.

There is a distinct difference in the skin type in the lower 40% of the STE (sebaceous, oily, prone to rosacea) and the thinner upper 60%. For this reason, one often uses solid dorsal grafts beneath diced cartilage grafts wrapped in temporal fascia (DC-F grafts) to augment the dorsum in black patients. One is attempting to "unify" the two skin sleeves—the transverse, thick, heavy lower lobular skin sleeve and the longitudinal, thin, upper dorsal skin sleeve. In thin-skin noses, all layers are thinner, and sometimes the smaller muscles are not even recognizable. In these cases, fascia is often added to cover the tip structures and prevent them from "showing" through the skin. In thin-skin patients, the middle third of the nose must be meticulously repaired using spreader grafts or flaps to avoid

SKIN THICKNESS AND LAYERS

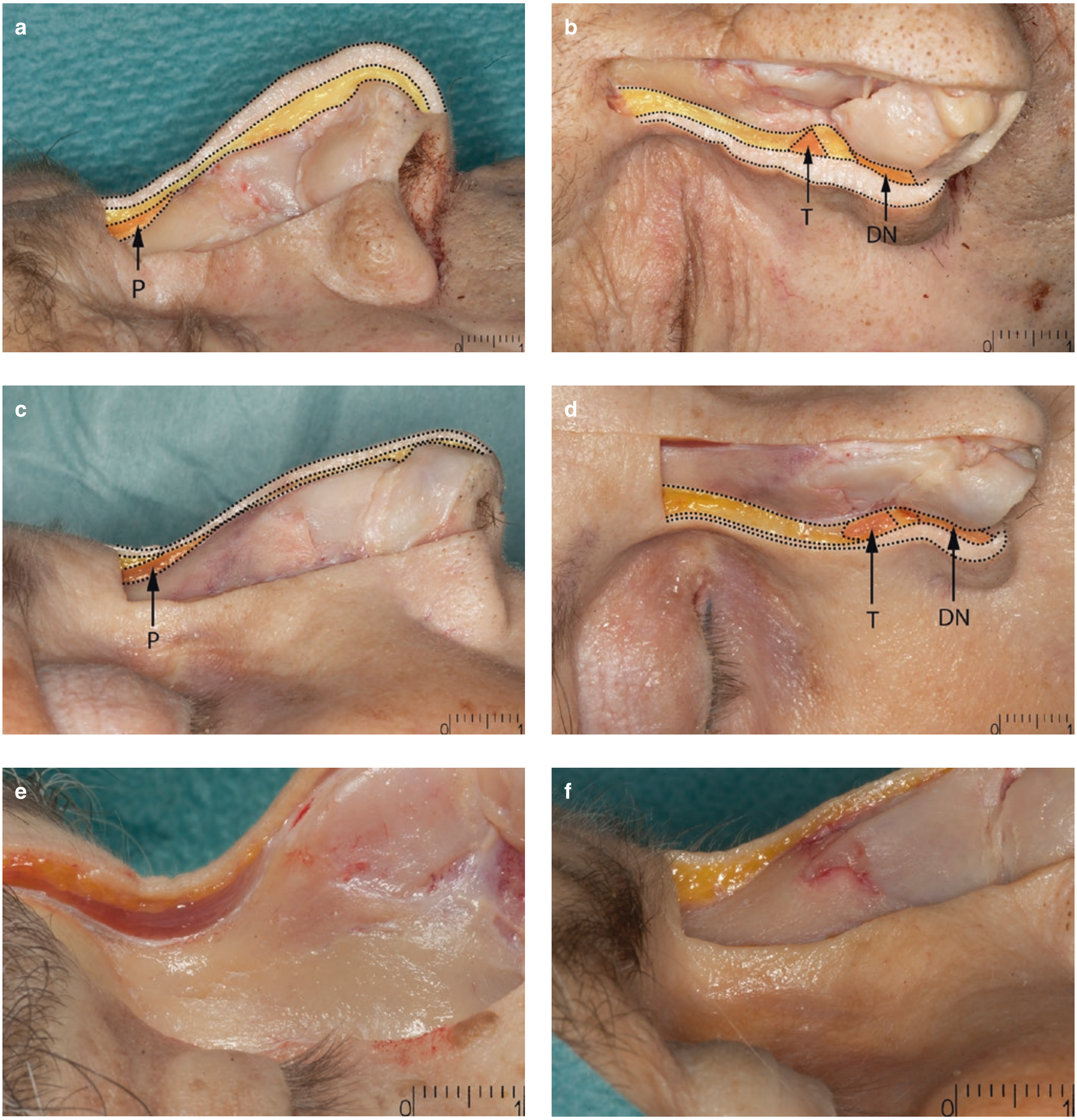


Fig. 1.13 Layers of the STE comprise the dermis (*white*), subcutaneous fat (*yellow*), and muscles (*orange*). (**a**, **b**) Thick skin, (**c**, **d**) thin skin, (**e**, **f**) muscular and fatty glabellar skin: note reciprocal relationship. *DN* dilator naris muscle; *P* procerus muscle; *T* transversalis muscle

an inverted-V deformity. More commonly, the challenge is how to deal with a thick STE, and especially how to achieve tip definition when the skin is unable to shrink onto the rigid underlying structure. In general, thick skin precludes subtle corrections and requires overcorrection. The cartilaginous tip angles must be sharper, and often tip grafts are set higher above the domes to show through the skin. Thick skin can be treated with defatting of the subcutaneous fat layer, but defatting must be done cautiously to avoid skin necrosis. The thickness of muscles also affects the total thickness of the skin, especially in the glabellar region, where the procerus muscle can be found (Fig. 1.13).

TELA SUBCUTANEA CUTIS

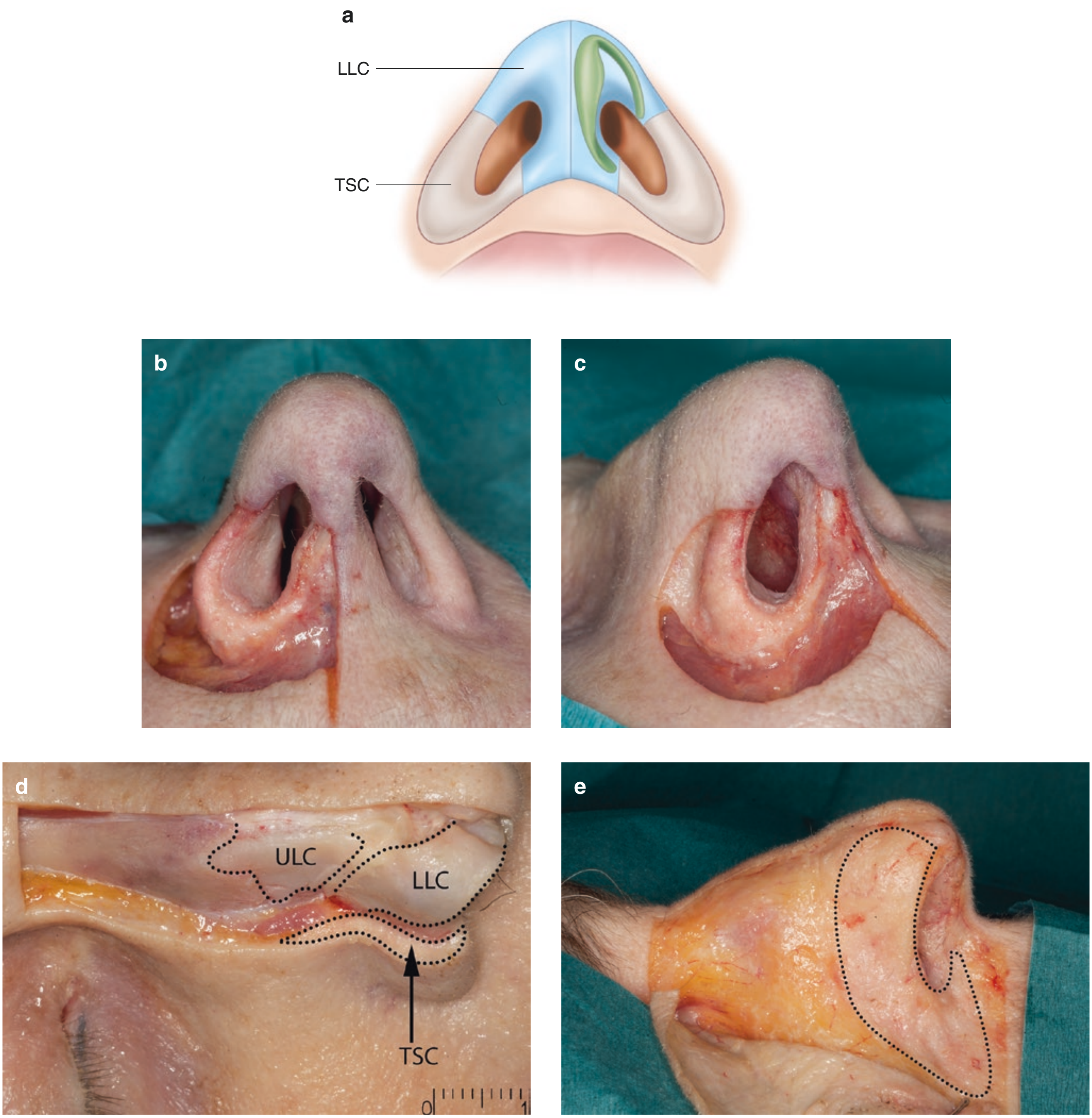


Fig. 1.14 (**a**) The extent of the tela subcutanea cutis (TSC), (**b**, **c**) The TSC determines the shape of the alar lobule and nostril sill, (**d**, **e**) Extent of TSC shown in cross-section and lateral extent. LLC lower lateral cartilage

The concept of the tela subcutanea cutis originates from anatomical descriptions (Goss 1973). Traditionally, surgeons concentrated on bony and cartilaginous components while ignoring the existence of a *distinct fibrous structure* underneath the skin, which gives form to the lower nasal base (Fig. 1.14). When we meticulously dissect the skin off the lower nasal base, it becomes obvious that the structure of the nostril sill and alar lobules is maintained (Daniel et al. 2013). Histologically, the curl of the nostril sill and the shape of the alar lobule are due to fibrous septae running from the deep dermal surface into the underlying muscles (Fig. 1.14c–e). This area is a distinct soft-tissue entity independent of the adjacent cartilages and underlying bones. Reduction of the nostril sills requires direct excision. The exception is the under-projecting tip with round nostrils, which can be mobilized medially onto a rigid columellar strut.

SUBCUTANEOUS FAT PADS AND INTERDOMAL FAT PAD

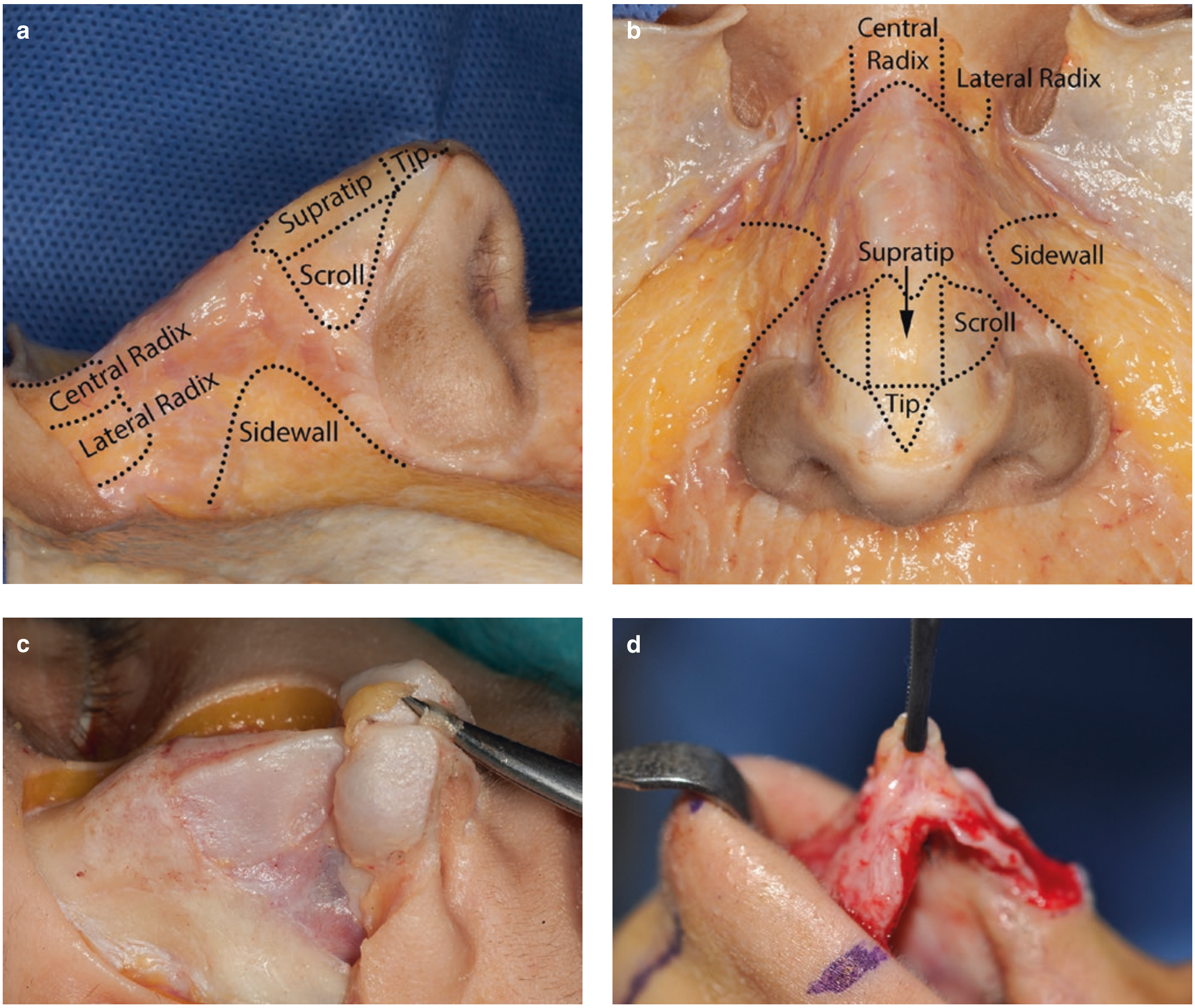


Fig. 1.15 Subcutaneous fat pads. (**a**, **b**) Cephalic and central subcutaneous fat pads. (**c**, **d**) Interdomal fat pad anatomically and clinically

The subcutaneous fat of the nasal region can be divided into three portions: cephalic, central, and lateral (Fig. 1.15). The cephalic subcutaneous fat can be subdivided into a central and lateral radix fat pad. The central radix fat pad overlies the procerus muscle while the lateral radix fat pad lies on the bone between the procerus and depressor supercilii muscle. The central subcutaneous fat can be subdivided into the tip, supratip, and scroll area fat pad. The tip subcutaneous fat pad lies above the interdomal fat pad. Interestingly, the tip subcutaneous fat pad does thin out around the domes, which means that the tip-defining points are basically cartilage-related. The *interdomal fat pad* is obvious at the time of surgery in most patients and has been confirmed on sonogram studies. Importantly, the presence of an interdomal fat pad answers one of the great mysteries of nasal aesthetics: What is the anatomical determinant of "T"? Ever since Sheen said that the tip (T) is the highest point on lateral view, it was implied that it is higher than the domes of the alar cartilages, yet what is it? In most patients, the tip convexity is created by the interdomal fat pad. In thin patients, one can see the convex domes through the skin, but the tip is often flat, not curved, because of a minimal interdomal fat pad.

SUPERFICIAL MUSCULOAPONEUROTIC SYSTEM (SMAS)

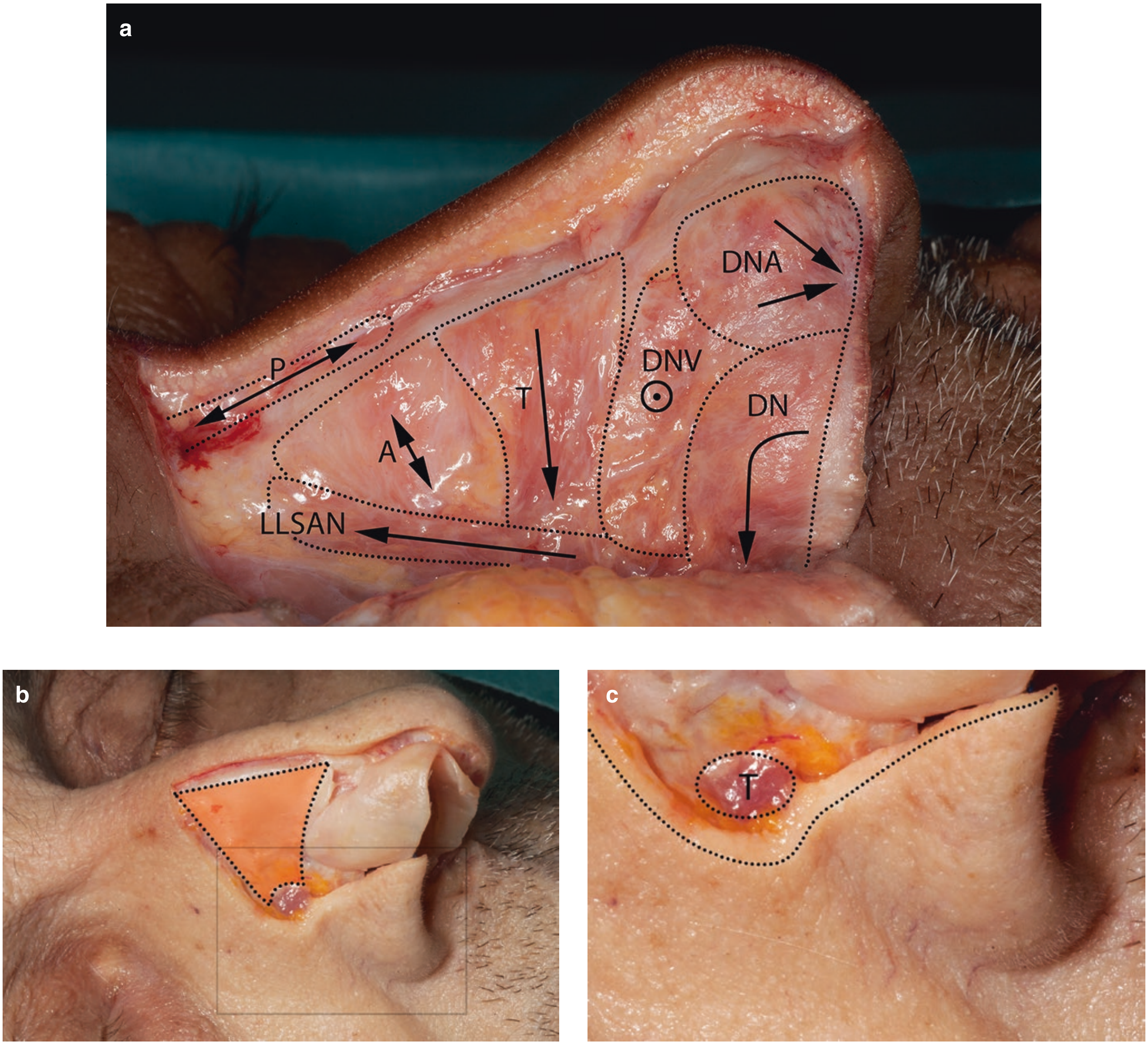


Fig. 1.16 (**a**) Muscles of the SMAS: procerus (P), anomalus (A), transverse nasalis (T), dilator naris vestibularis (DNV), dilator naris anterior (DNA), dilator naris (DN), levator labii superioris alaeque nasi (LLSAN). (**b**, **c**) Relationship of the transverse nasalis muscle (T) to the alar crease and the nasolabial fold at the level of the mucosal space

As originally described by Letourneau and Daniel (1988), the nose is covered by a nasal superficial musculoaponeurotic system (SMAS), which is part of the facial SMAS (Fig. 1.16). An aponeurosis interconnects the superficial muscles of the nose, thus distributing their forces. The muscles inserting into the alae come off from the maxilla and can affect nasal respiration by changing the transnasal pressure of the nasal valves (Saban et al. 2008). There are numerous descriptions of the nasal musculature, but we prefer our own cadaver macroscopic observations. Griesman (1944) divided the muscles functionally into four groups: elevators, depressors, compressors, and minor dilator muscles (Figs. 1.17 and 1.18).

Elevators, including the procerus (P) and levator labii superioris alaeque nasi (LLSAN), shorten the nose and dilate the nostrils. P originates from the aponeurosis of the transverse nasalis and the periosteum of the nasal bones, before inserting into the glabellar skin. LLSAN originates from the periosteum of the frontal process of the maxilla, medial to the orbicularis oris muscle, and inserts some fibers into the ala, but it mainly inserts into the modiolus nasi and the columellar base.

SUPERFICIAL MUSCULOAPONEUROTIC SYSTEM (SMAS)

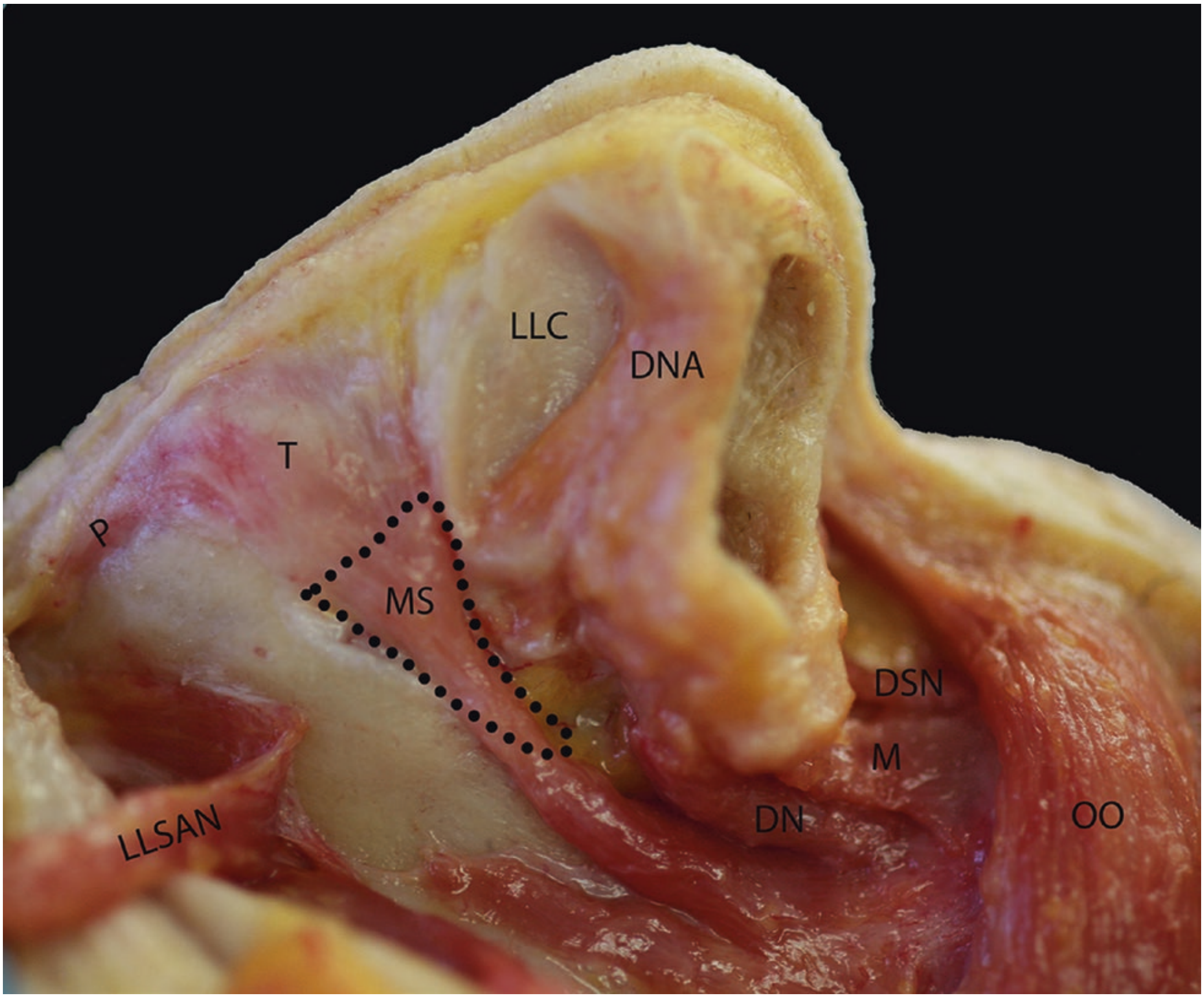


Fig. 1.17 Nasal musculature. Orbicularis oris (OO), transversalis (T), depressor septi nasalis (DSN), myrtiformis (M), dilator naris (DN), levator labii superioris alaeque nasi (LLSAN), lower lateral cartilage (*LLC*), procerus (*P*), and mucosal space (MS)

Depressors lengthen the nose and dilate the nostrils. They include the depressor septi nasalis (DSN), dilator naris or alar portion of the nasalis (DN), myrtiformis muscle (M), and the superficial orbicularis oris nasalis (SOON). The DSN originates from the periosteum of the maxilla above the central incisor, and inserts onto the footplates of the medial crura and the deep layer of Pitanguy's midline ligament. The main portion of the DN originates from the periosteum of the maxilla above the canine tooth, just lateral to the origin of the myrtiformis muscle and medial to the origin of the transversalis muscle. A less obvious caudal portion of the DN originates from the superficial layer of the modiolus nasi. DN inserts into the alar base and thus becomes the main dilator of the nostril. M originates from the myrtiform fossa of the maxilla, just above the lateral incisor and canine teeth. It divides into an anterior labial part, which goes to the upper lip, and a posterior nostril part, which inserts on the nostril floor. It depresses and dilates the nostrils.

Compressors lengthen the nose and narrow the nostrils. They include the transverse nasalis (T). T originates from the periosteum of the maxilla above and lateral to the incisor fossa. It interdigitates on the nasal dorsum with its counterpart from the opposite side and the procerus muscle to form a sling. The belly of the muscle overlies Hocksteder's mucosal space, thus allowing it to function as a bellow. Some fibers insert into the skin of the nasolabial fold and alar crease, as well as join the dilator naris muscle. Contraction of this muscle results in downward movement of the cephalic rim of the lateral crura, thus compressing the vestibule.

SUPERFICIAL MUSCULOAPONEUROTIC SYSTEM (SMAS)

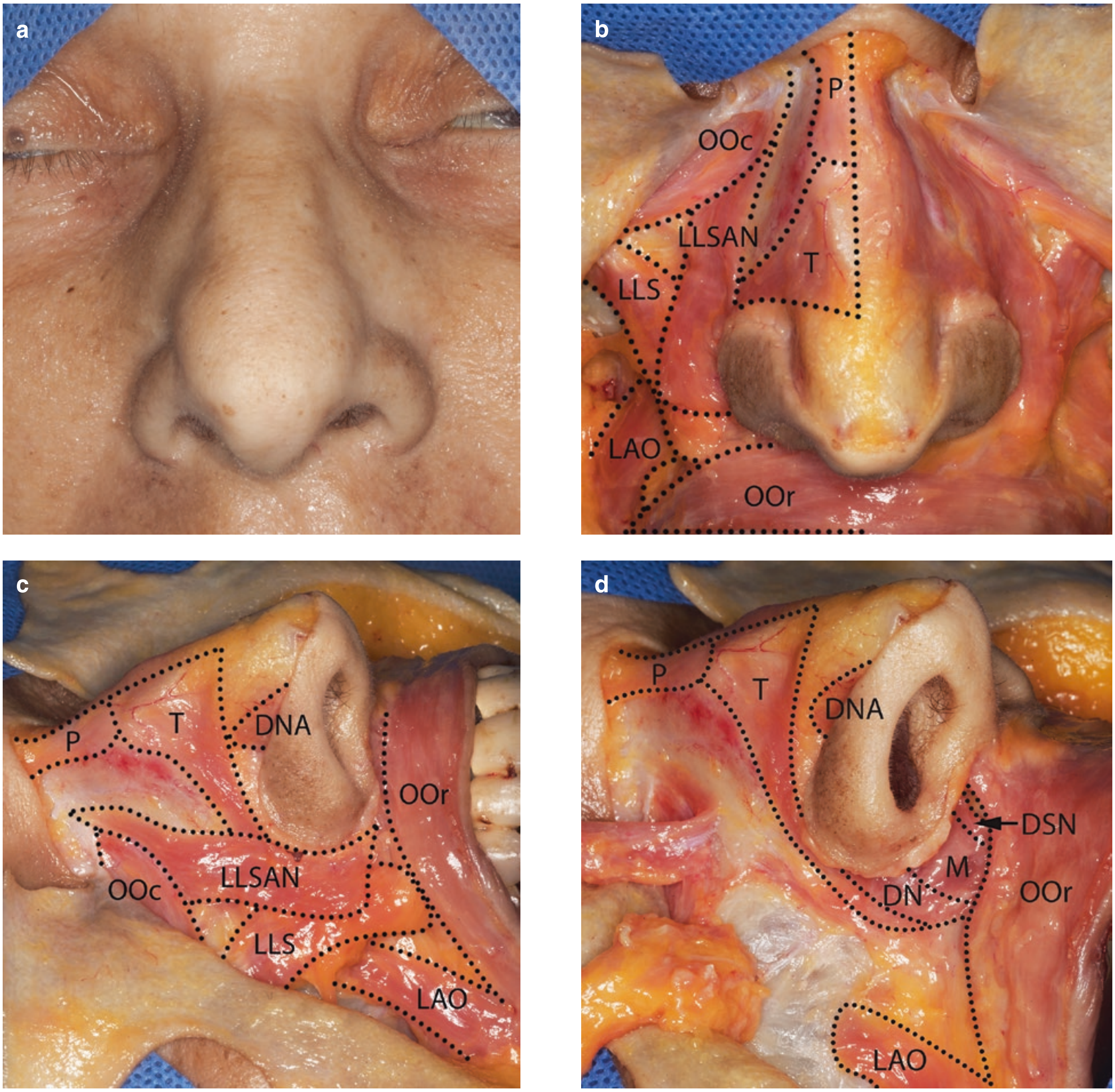


Fig. 1.18 (**a–d**) Nasal SMAS. Procerus (P), orbicularis oculi (OOc), levator labii superioris alaeque nasi (LLSAN), transverse nasalis (T), levator labii superioris (LLS), levator anguli oris (LAO), orbicularis oris (OOr), dilator naris anterior (DNA), dilator naris (DN), depressor septi nasalis (DSN0, myrtiformis (M)

As emphasized by Figallo and Acosta (2001), the nasal muscles have been “sliced and diced” over the years into numerous entities, with certain ones dropped for decades, only to be resurrected. Currently, the concept of the SMAS layer covering the entire nose has become accepted. This continuity of muscle coverage and its actions through an aponeurosis with ligamentous attachments has altered our concepts of nasal respiration. One of the most recent discussions has revolved around the “dilator naris” and the “modiolus” of the nose Traditionally, there was a question as to whether the dilator naris was a part of the transverse nasalis muscle (T) or a separate entity. Currently, we tend to think there are three dilators: the dilator naris (DN), the dilator naris anterior (DNA), and the dilator naris vestibularis (DNV). The DNA originates from the surface of the lateral crus and inserts into the nostril rim. It is seen during skin elevation from the infracartilaginous incision. The DNV, which is rarely visible macroscopically, originates from the tail of the lateral crura and the accessory cartilages before inserting into the deep dermal surface of the alar groove (Hur et al. 2011).

SUPERFICIAL MUSCULOAPONEUROTIC SYSTEM (SMAS)

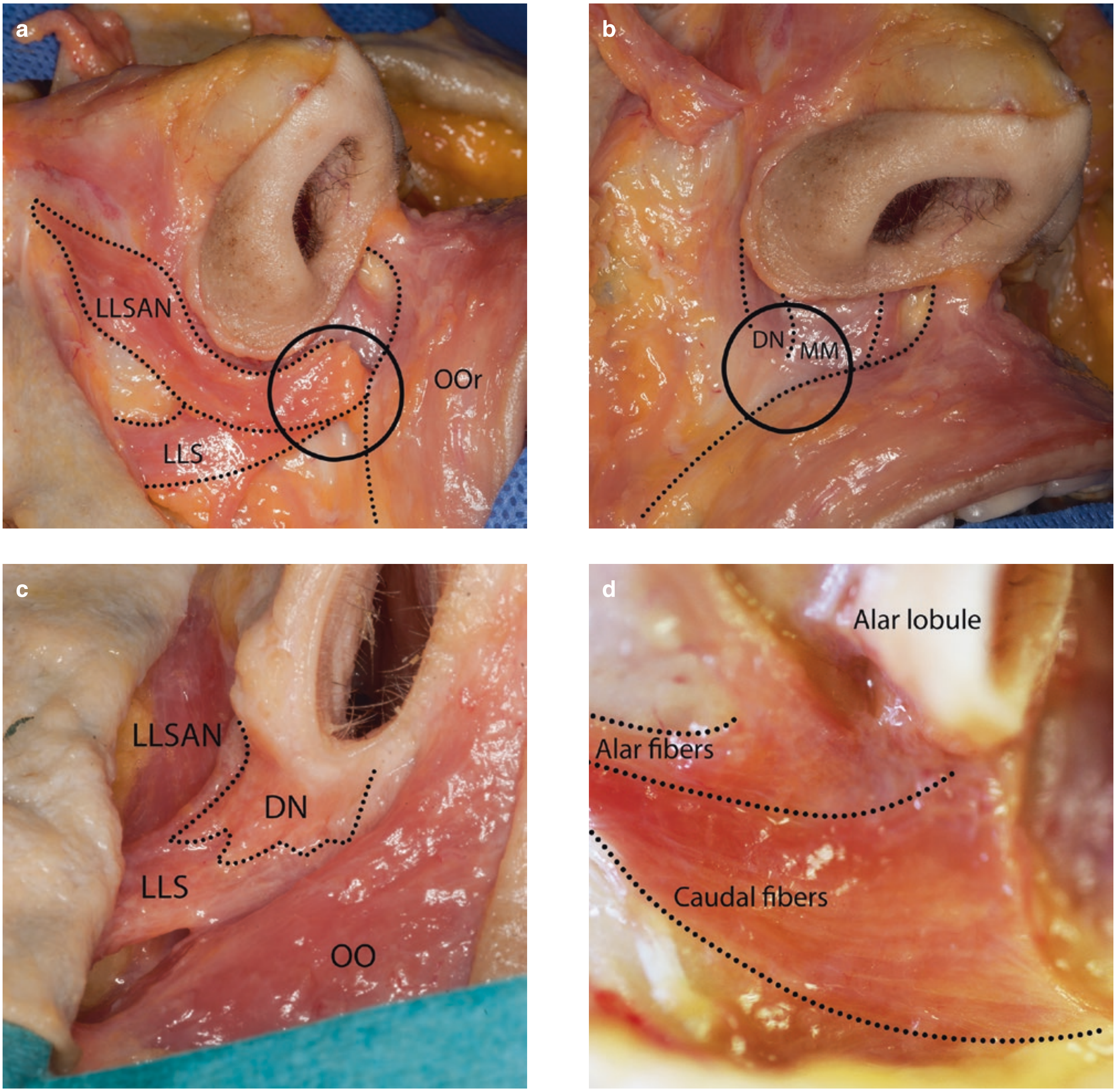


Fig. 1.19 Modiolus nasi. (**a**) Superficial layer. (**b**) Deep layer. (**c**) Caudal portion of the dilator naris. (**d**) Lateral close-up view of LLSAN muscle lateral to the alar lobule. *MM* myrtiformis muscle

As referred to in the oral area, a modiolus is a chiasma of facial muscles held together by fibrous tissue. At the alar base, the *modiolus alae nasi* is composed of multiple muscles that depress and expand the nostril, thus serving as a counterbalance to the lifting, narrowing muscles. Our dissections defined the existence of a modiolus alae nasi as a two-layer structure (Fig. 1.19). The *superficial layer* courses transversely and comprises the LLSAN, levator labii superioris, and superficial orbicularis oris, plus the caudal portion of the DN, which has an origin in the modiolus nasi. Based on the course of the individual muscles, it is obvious that their contracture expands the nostril laterally, whereas the predominant levator muscles elevate the nostril base. Functionally, these muscles provide countertension to the depressor muscles. The *deep layer* courses vertically and comprises the myrtiformis muscle and DN. These fibers have a broad insertion around the entire alar base and up into the nostril sill (Daniel et al. 2013).

SONOGRAM ANALYSIS OF SKIN THICKNESS

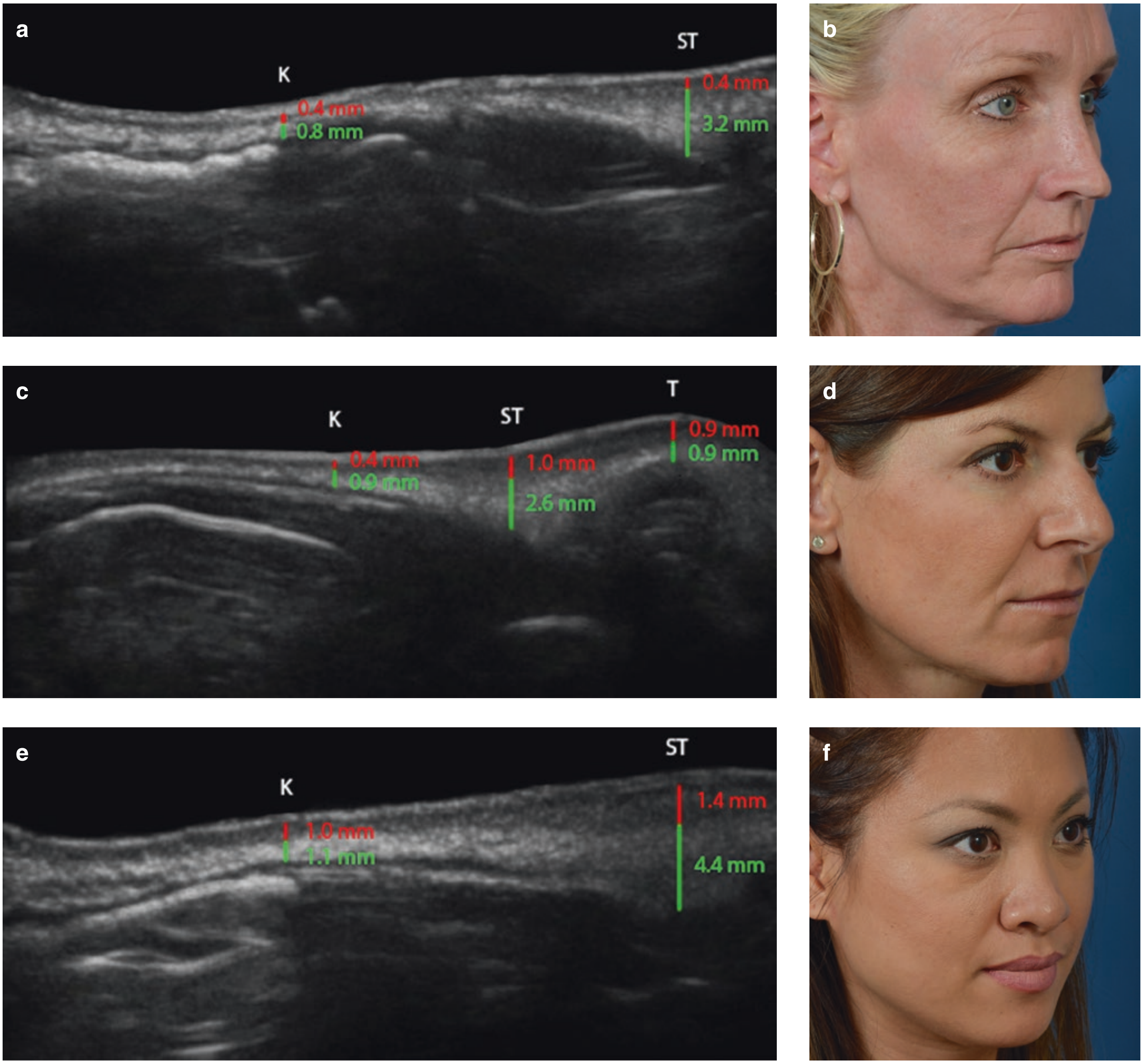


Fig. 1.20 Sonograms of nasal skin, showing the thickness of the dermis (*red*) and SMAS (*green*). (**a**, **b**) Thin skin. (**c**, **d**) Medium skin. (**e**, **f**) Thick skin. *K* keystone junction; *ST* supratip; *T* tip (*Sonograms courtesy of* Aaron Kosins, MD.)

Sonogram analysis of the nasal skin is an extremely valuable tool, both for preop and postop analysis in rhinoplasty surgery. Patients found to have thin skin had a dermal thickness at the keystone junction (K) of 0.2 mm (0.1–0.4 mm), compared with 0.36 mm (0.28–0.40 mm) for normal skin and 0.48 mm (0.42–0.63 mm) for thick skin (Fig. 1.20) (Kosins and Obaghi 2017). This difference in thickness also existed in the supratip and tip areas, but these areas were also affected by the oiliness of the skin. Overall, patients with skin that was determined to be oily had a dermal thickness that was 25% thicker at the supratip and 34% thicker at the tip area. Soft tissue thickness underlying the dermis was variable. Patients of non-Caucasian background were more likely to have a thicker soft tissue layer. Patients with thick skin can be divided into those with thick dermis, thick underlying soft tissue, or both.

SONOGRAM ANALYSIS OF SKIN THICKNESS

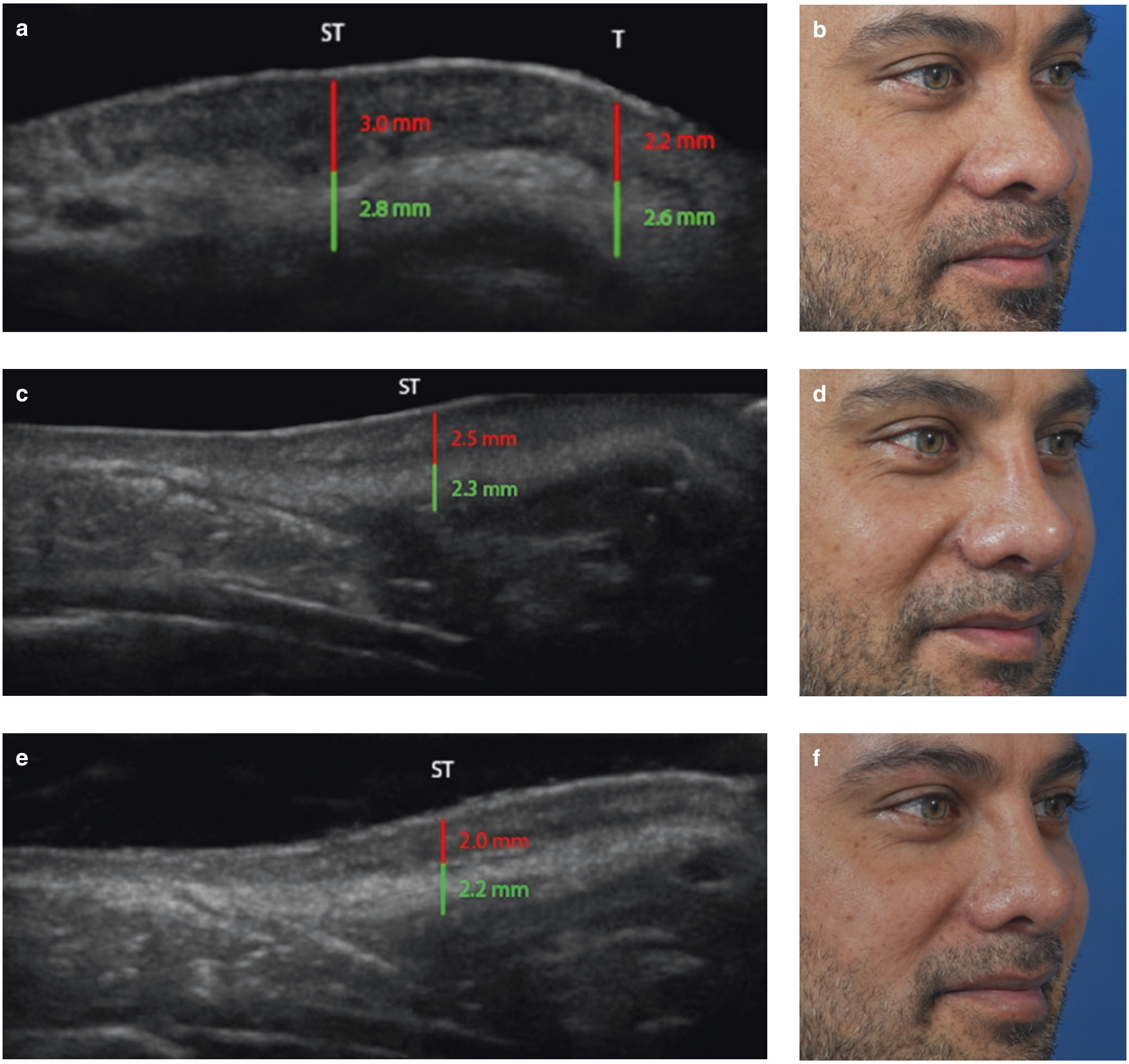


Fig. 1.21 Patient with a thick-skin STE composed of a thick lower part and thin upper part. (**a**, **b**) Preop sonogram and photo. (**c**, **d**) Views 4 weeks postop, prior to start of Accutane®. (**e**, **f**) Views 4 months after surgery and 3 month course of Accutane. The vertical measurements show dermis (*red*) and SMAS (*green*). Note: there has been a full 1 mm thinning of the dermis (33%) and 0.6 mm of the deep soft tissue (25%). *ST* supratip; *T* tip

Patients who have a thick dermis benefit from *preconditioning* with a combination of salicylic acid, mechanical scrub, alpha hydroxyl acids, and retinoids to shrink the oil glands. Patients who have thick underlying soft tissue are routinely defatted using an open approach by dissecting at a subdermal level, followed by resection of the intervening soft tissues down to the cartilage level. Selected patients benefit from a *postoperative* treatment program with either 20 mg of isotretinoin (Accutane®) started at 4 weeks and continued for 4–5 months to decrease the size of the oil glands, with optional CO_2 Fraxel® (Solta Medical; Hayward, CA) for textural smoothing. The patient shown in Fig. 1.21 had extremely thick skin, which was defatted intraoperatively. A dorsal graft was inserted to unify the two skin sleeves.

NEUROVASCULAR STRUCTURES

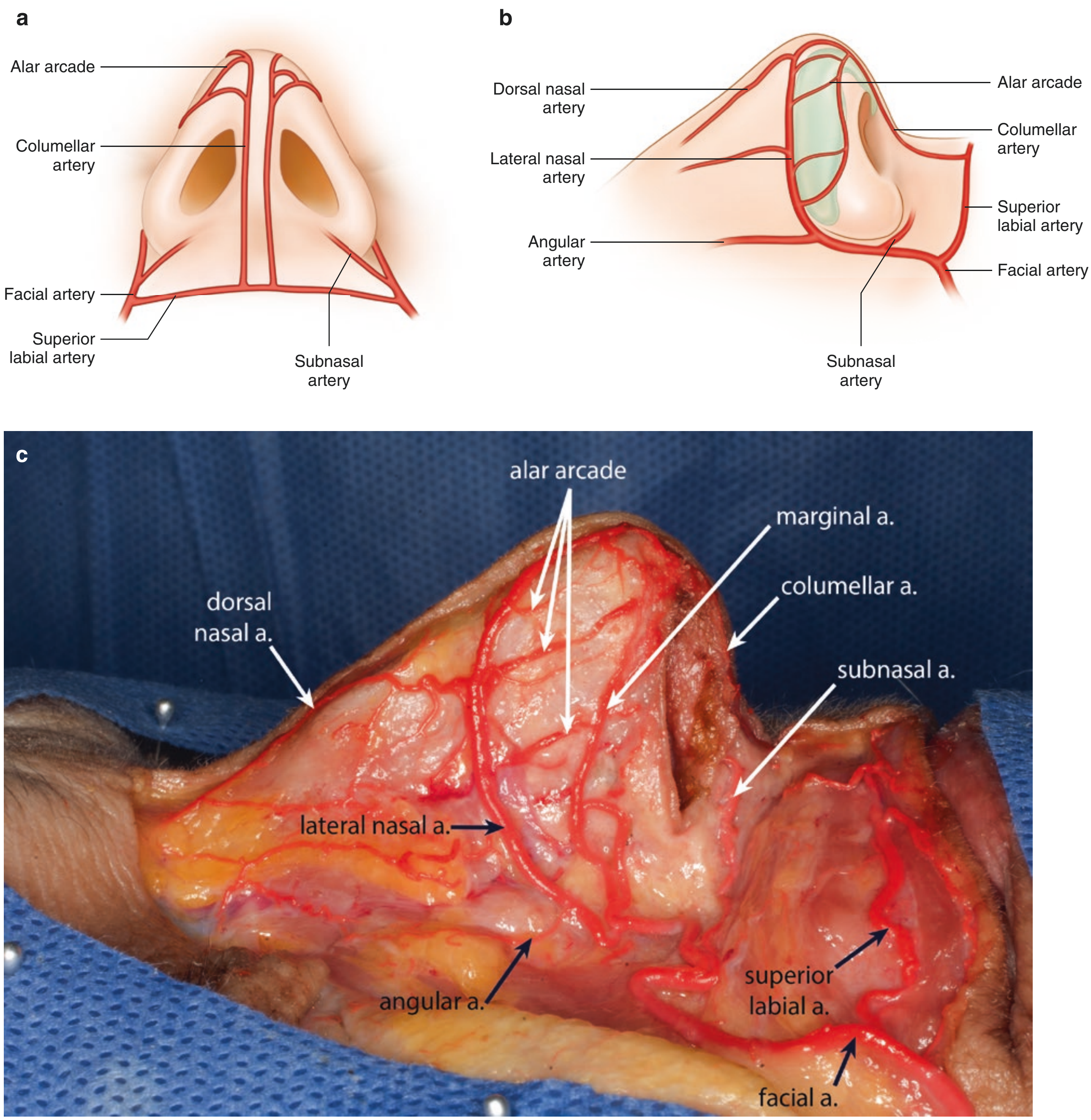
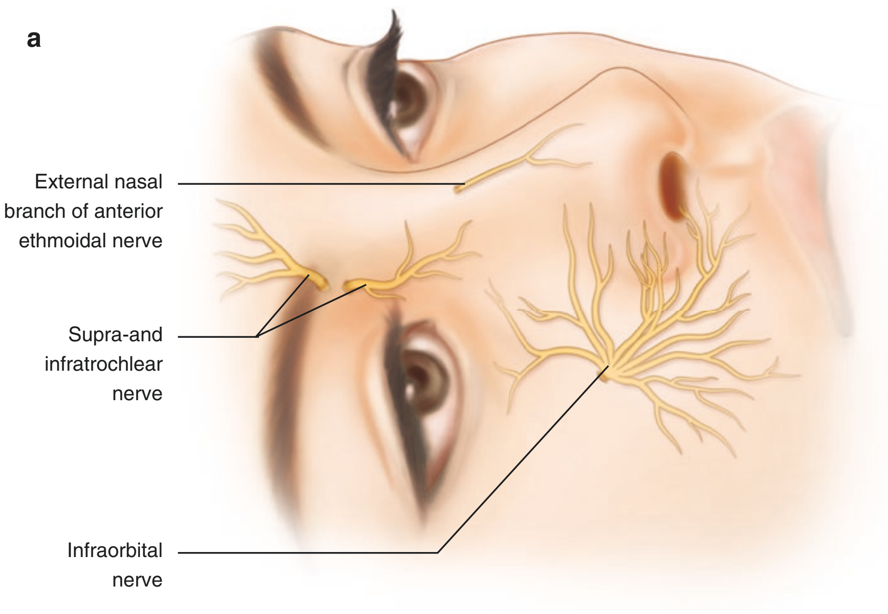


Fig. 1.22 (**a–c**) Arterial anatomy

The arterial blood supply to the nose comes via three distinct vessels: the lateral nasal artery, columellar artery, and dorsal nasal artery (Fig. 1.22). The facial artery divides into a superior labial artery and an angular artery near the labial commissure. A pair of columellar arteries branch off of the superior labial artery in the middle of the upper lip. The lateral nasal artery branches off of the angular artery at the level of the alar groove and runs along the cephalic margin of the lateral crus. The dorsal nasal artery is a continuation of the ophthalmic artery. All of these vessels are interconnected through *vascular arcades* and terminate in the dermal plexi. As emphasized by Toriumi et al. (1996), the vascular system was found in the subcutaneous plane above the SMAS layer. Surgically, dissecting in the areolar plane below the SMAS leads to minimal disruption of the vasculature and bleeding.

NEUROVASCULAR STRUCTURES



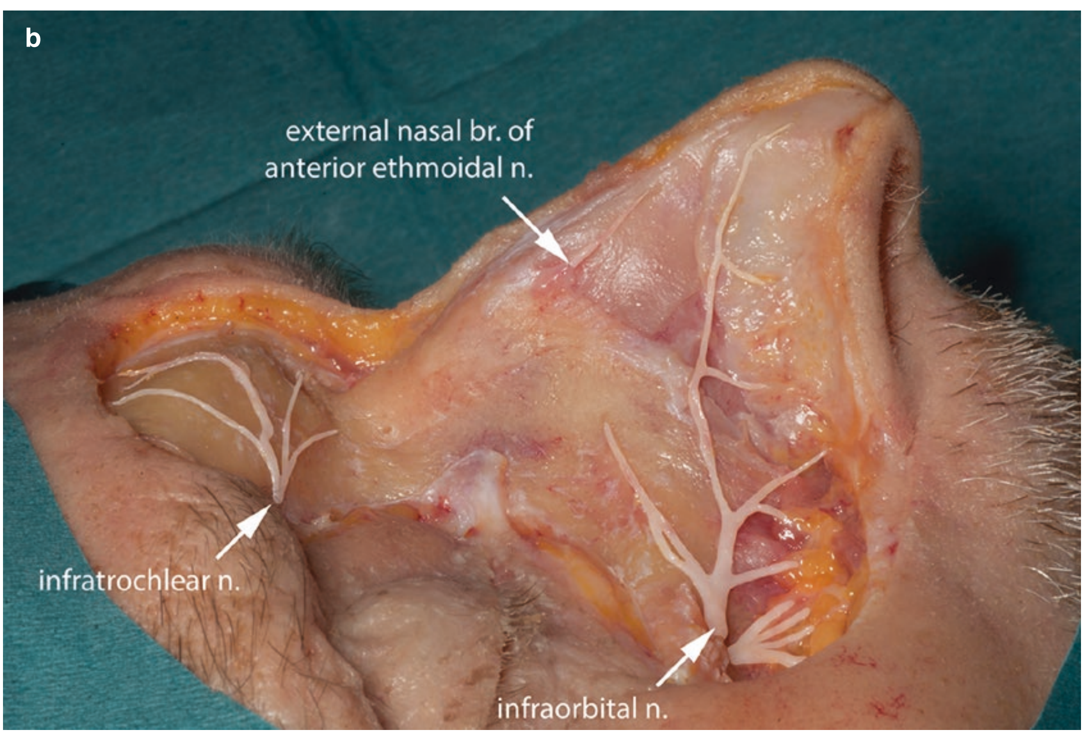


Fig. 1.23 (**a**, **b**) Sensory innervation

The sensory nerves of the nose come from the ophthalmic and maxillary divisions of the 5th cranial nerve (Fig. 1.23). The radix area, upper dorsum, and upper lateral wall are supplied by branches from the supratrochlear and infratrochlear nerves derived from the ophthalmic nerve. The lower dorsum and tip are innervated by the external nasal branch of the anterior ethmoidal nerve, which emerges from between the nasal bone and upper lateral cartilages (ULC). Innervation of the lower lateral wall, alar base, and vestibule are derived from the infraorbital nerve. At the end of the operation, we do a bilateral field block of these nerves with 0.5% bupivacaine to minimize immediate postoperative pain.

EXPOSURE: TIP AND DORSUM

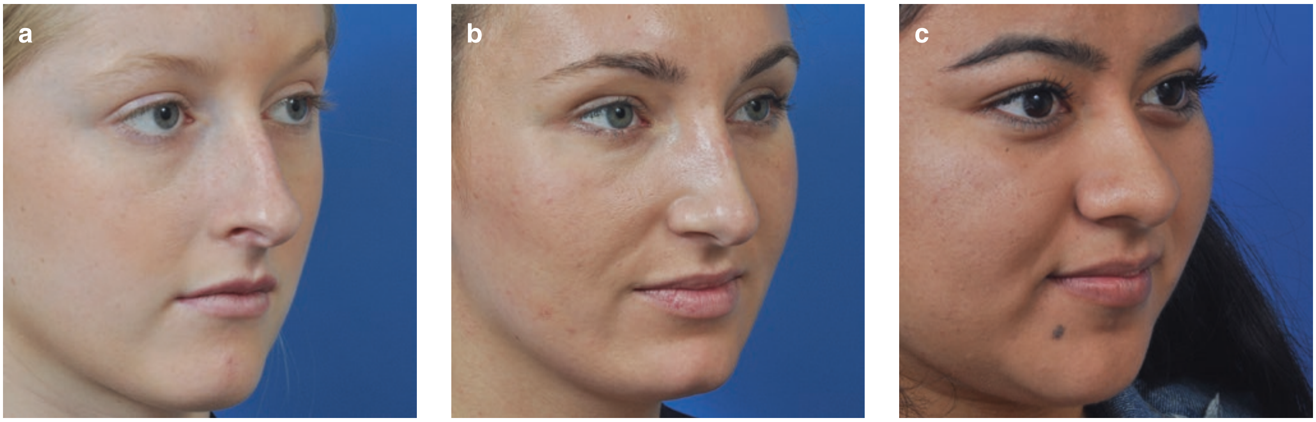


Fig. 1.24 (**a–c**) Three consecutive patients with thin, normal, and thick STEs, requiring different dissection planes

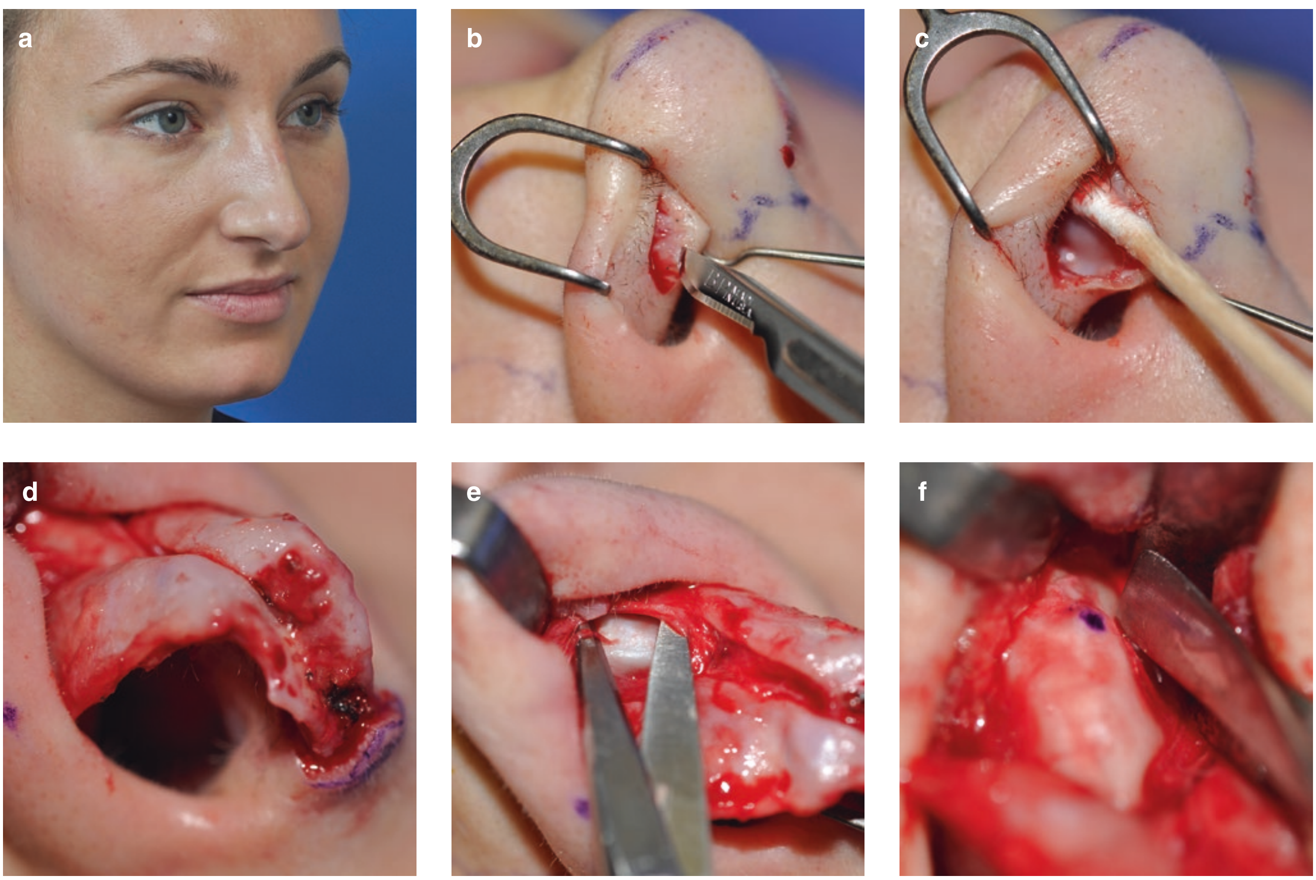


Fig. 1.25 (**a–f**) Standard sub-SMAS exposure in the patient with normal STE thickness

The three patients shown in Fig. 1.24, who happened to be done consecutively, demonstrate the need for the surgeon to alter the dissection plane based upon the patient's STE. The standard sub-SMAS dissection plane (Fig. 1.25) is an avascular plane just above the perichondrium, which is easily elevated in the tip area using a Q-tip. In contrast, the subperichondrial plane (Fig. 1.26) requires sharp (knife) dissection to enter the plane, and then careful sweeping with a perichondrial elevator. The subdermal exposure is done in two steps. First, the skin envelope is raised in the subdermal plane using a closed approach (Fig. 1.27). Then the skin is elevated through an open approach, and the thick soft tissue is exposed and excised from the underlying alar cartilages.

EXPOSURE: TIP AND DORSUM

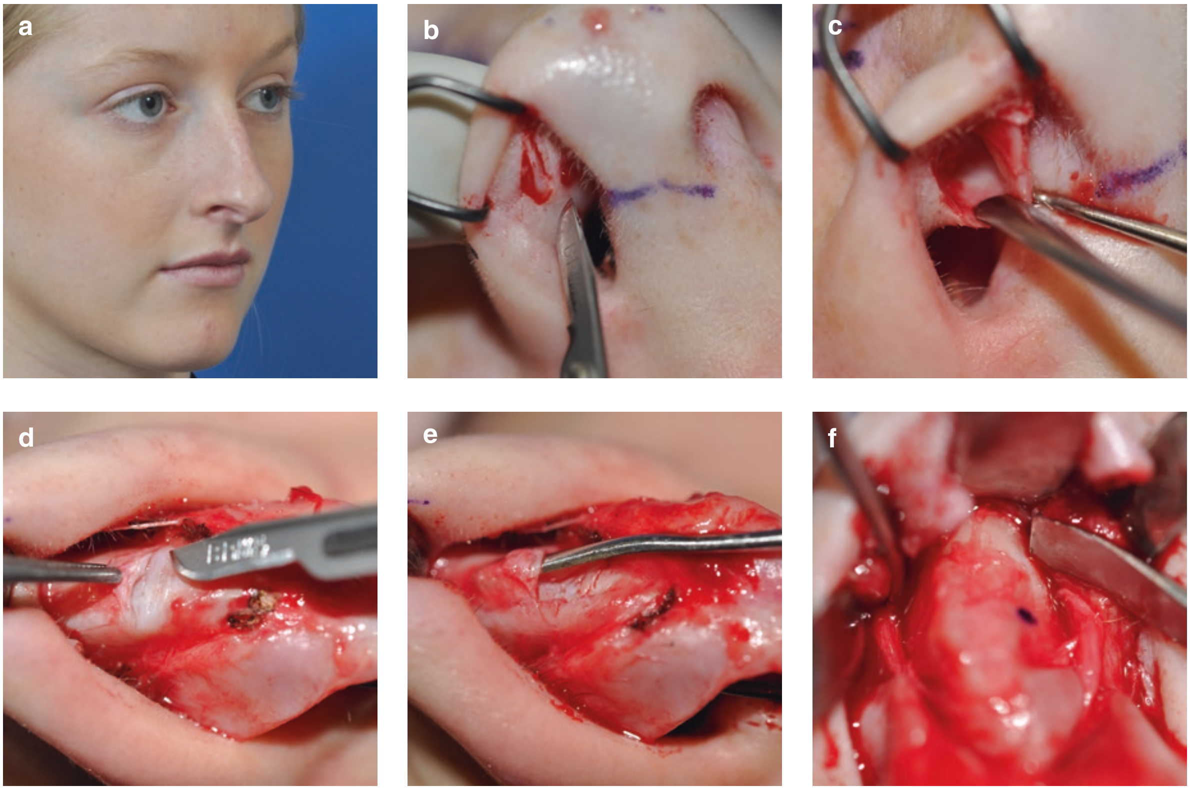


Fig. 1.26 (**a–f**) Subperichondrial exposure in the patient with the thin STE

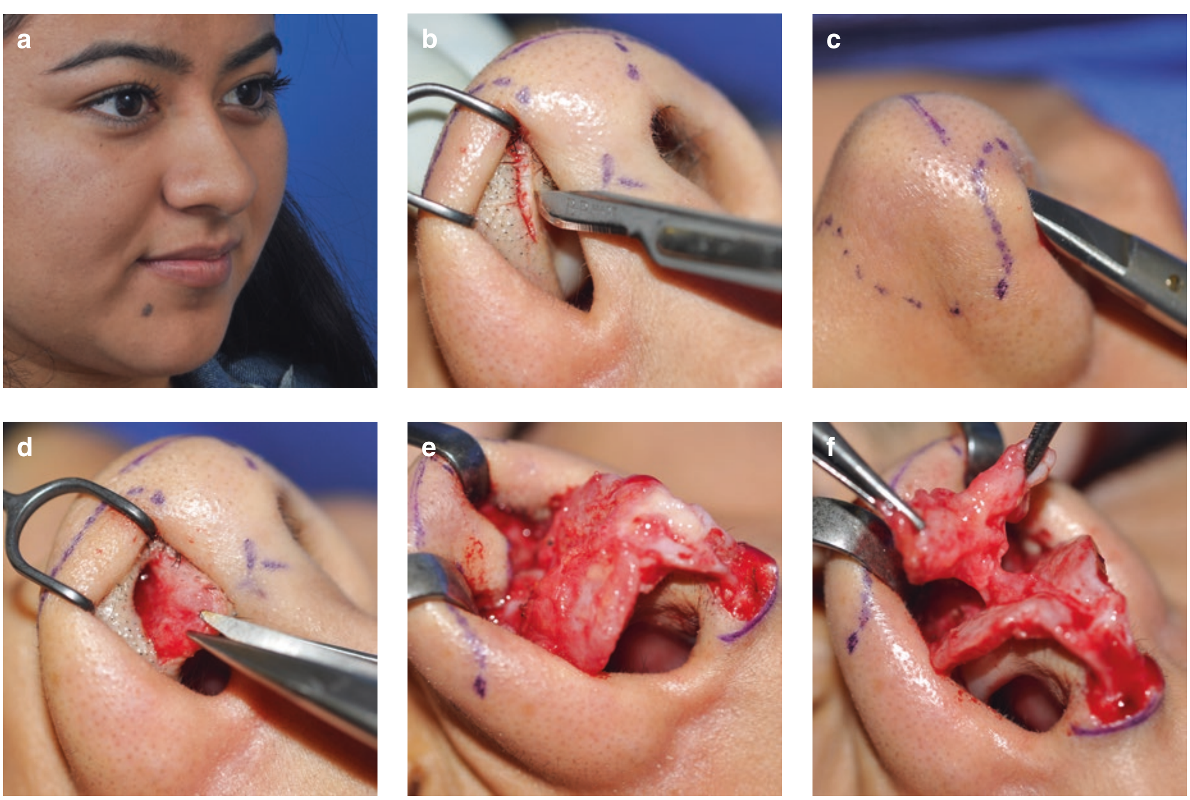


Fig. 1.27 (**a–f**) Subdermal exposure (first step) in the patient with the thick STE

THICK SKIN (CASE STUDY)

Analysis: An 18-year-old student of Hispanic and Middle Eastern descent requested a rhinoplasty. Her skin was extraordinarily thick and the shape was amorphous. Because there would be no major profile change, the challenge became how to achieve definition through a very thick skin sleeve. In addition, the nose was quite wide (X–X: 32, AC–AC: 33, AL–AL: 43 = +10 mm), creating additional problems (Fig. 1.28).

Operative Technique: This surgery used an open approach with dissection in the subdermal plane and maximum soft tissue defatting.

1. Dorsal exposure. No bony reduction. Cartilage vault shaping, reduction <0.5 mm.
2. Septal harvest. Medial oblique and low to high osteotomies.
3. Narrowing of columellar base, with muscle excision and suturing of footplates to strut.
4. Open structure tip graft with projection 5 mm above the domes. Cap graft to support tip graft.
5. Weir-type alar wedge excisions: 5 mm wide.

Commentary: At time of closure, the tip blanched white with ultra-tip definition. By 6 weeks postop, the skin envelope was thick, and it was elected to inject dilute Kenalog® (10 mg, diluted 50% with local anesthesia) throughout the supratip area. A second injection was done 6 weeks later. As seen at 2 years postop, the nose is better, but the refinement is limited by the thick skin sleeve (Fig. 1.29). It was this patient that led us to consider a postop course of low-dose Accutane® in very selected patients. Note: the shiny skin seen in certain postop patients is due to the use of alcohol to remove make-up immediately prior to photography.

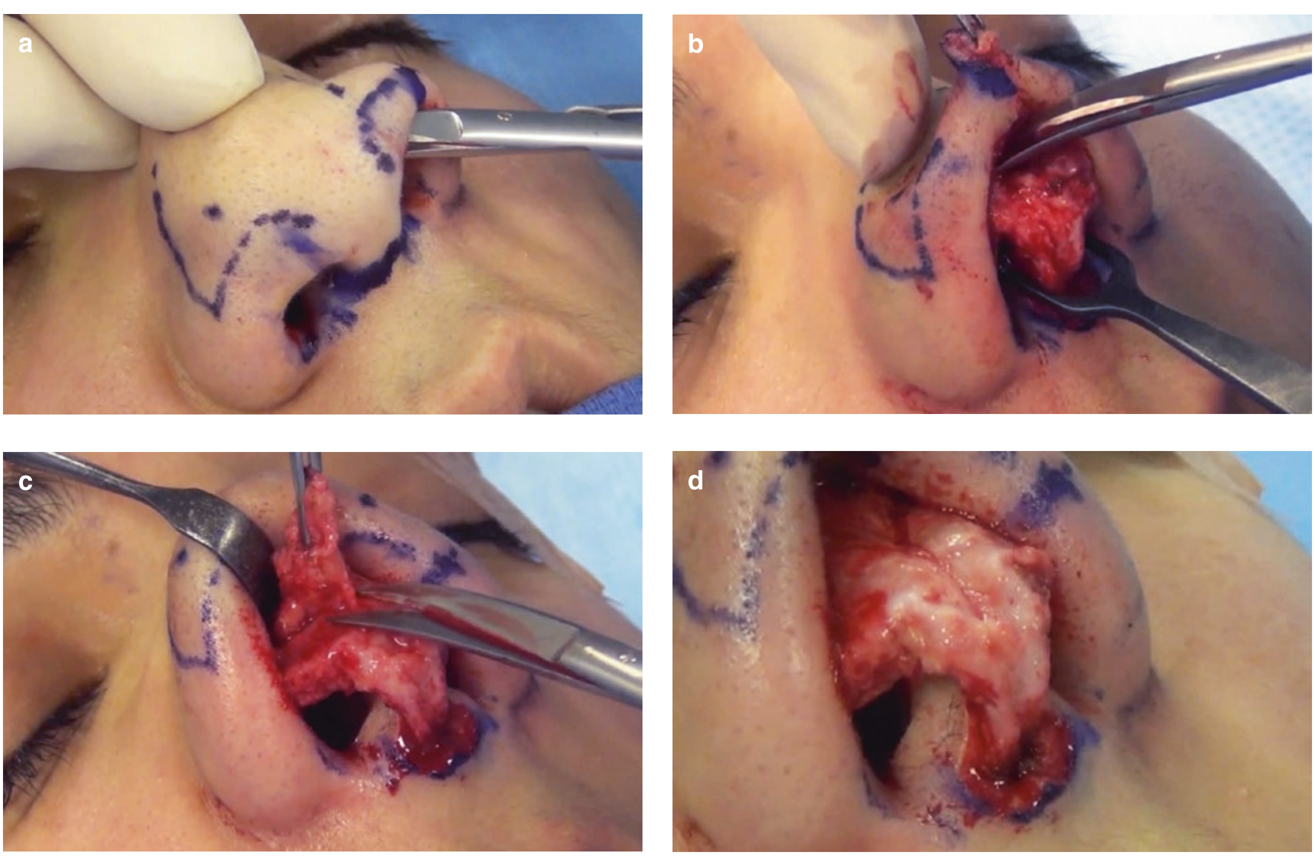


Fig. 1.28 (**a–d**) Dissection in the subdermal plane followed by soft tissue defatting

THICK SKIN (CASE STUDY)

Fig. 1.29 (**a–h**) Case study patient before (*left*) and 2 years after (*right*) treatment

THICK SKIN (CASE STUDY)

Analysis: A 54-year-old woman of Hispanic descent presented for rhinoplasty. She was classified as having a Type IV Hispanic nose with many Creole/Black characteristics. The challenges were a thick, amorphous skin sleeve, a heavy tip with dorsal base disproportion, and wide nostrils (X–X: 32, AL–AL: 43, = +11 mm). Because of her thick, oily skin envelope, she was begun on a preop skin regimen. A postoperative course of Accutane® was discussed with the patient, who agreed.

Operative Techniques:

1. Open approach with subdermal plane dissection. Maximum soft tissue excision (Fig. 1.30a).
2. Note: no alar cartilage excision, no dorsal reduction.
3. Septal harvest. Tomahawk septocolumellar strut: 15 mm wide, 35 mm high (Fig. 1.30b).
4. Insertion of strut. Open structure tip graft (5 mm projection above domes) and cap graft (Fig. 1.30c, d).
5. Diced cartilage in fascia graft (DC-F): 25 × 5 mm placed into the radix, upper dorsum.
6. Combined nostril sill/alar base excision with cinching of the nostril sill component.

Commentary: Essentially, the limiting factor was how much the lobular skin sleeve could be shrunk. The steps included defatting of the skin sleeve, triangular projection of the alar cartilages on the tomahawk strut plus a tip graft, and reduction of alar flare and narrowing of the nostrils with the combined nostril sill/alar base excision. Once the lobule was reduced, then the dorsum was augmented with the DC-F graft. At 4 weeks postop, the patient was begun on a 4-month course of isotretinoin (Accutane® 20 mg OD) without any morbidity (Fig. 1.31). Patient is seen 1.5 years postop and 1 year following discontinuation of Accutane®.

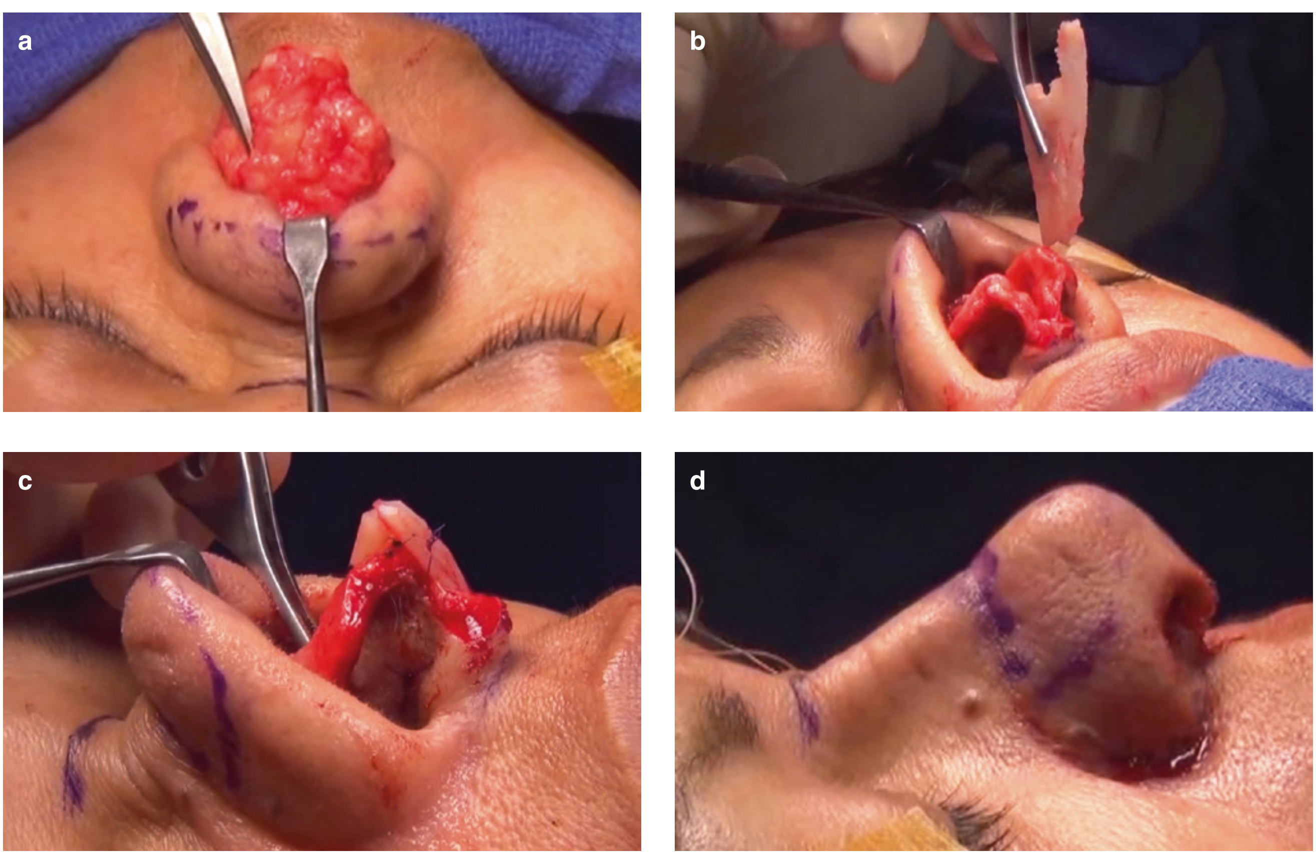


Fig. 1.30 Operative technique in patient with thick skin. (**a**) Subdermal dissection. (**b**) Tomahawk septocolumellar strut. (**c**, **d**) Open structure tip graft and cap graft

THICK SKIN (CASE STUDY)

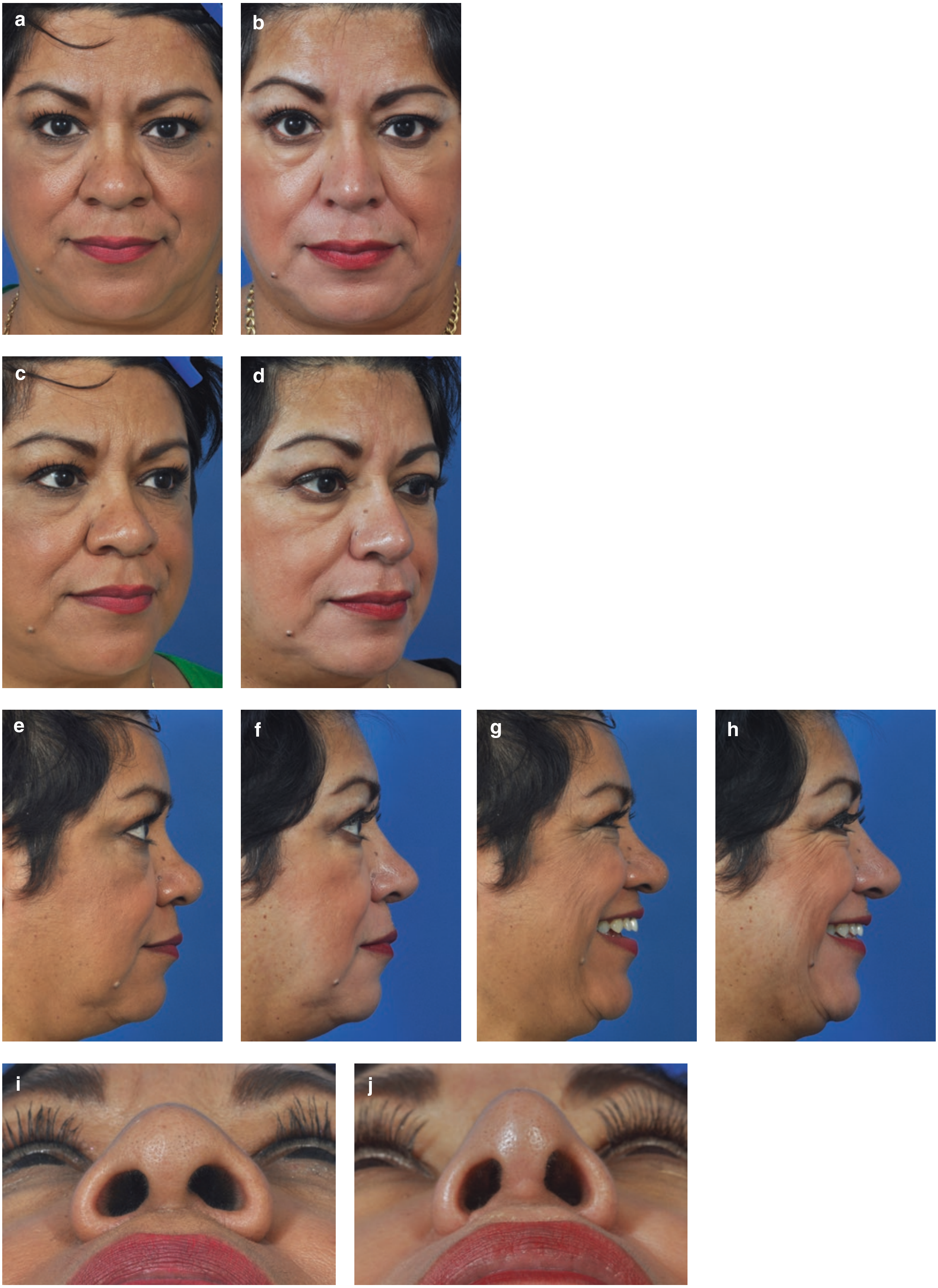


Fig. 1.31 (**a–j**) Case study patient before (*left*) and 1.5 years after (*right*) treatment

THIN SKIN, DORSAL IRREGULARITIES (CASE STUDY)

Analysis: A 27-year-old woman requested a rhinoplasty to correct her bony hump, ball tip, and plunging tip. She particularly disliked her irregular, visible dorsal lines. On analysis, the columellar double break showed retraction of the columellar limb and hanging of the infralobule. On basilar view, the alar rims were unsupported.

Operative Technique:
1. Harvest of a sheet of deep temporal fascia (Fig. 1.32a, b).
2. Open approach in standard sub-SMAS plane.
3. Incremental dorsal reduction (B: 0.5 mm, C: 3 mm). 2.5-mm caudal septal resection.
4. No osteotomies. "Contoured fill" spreader grafts tapered from 2.5 mm cephalic.
5. Insertion columellar strut. 2-mm domal excision with repair. Cover with fascia graft.
6. Placement of a" fascial blanket" graft over the dorsum and tip (Fig. 1.32c, d).
7. Insertion of alar rim grafts.

Commentary: This patient had extraordinarily thin skin and very visible dorsal lines, which she did not like. The bony cap was removed with a rasp, and the upper laterals were detached and partially excised. Spreader grafts were used to fill the open roof and tapered to contour the cartilage component of the dorsal lines. At 1 year, the fascia graft has helped to hide the dorsal irregularities and avoid "shrink wrapping" of the STE (Fig. 1.33).

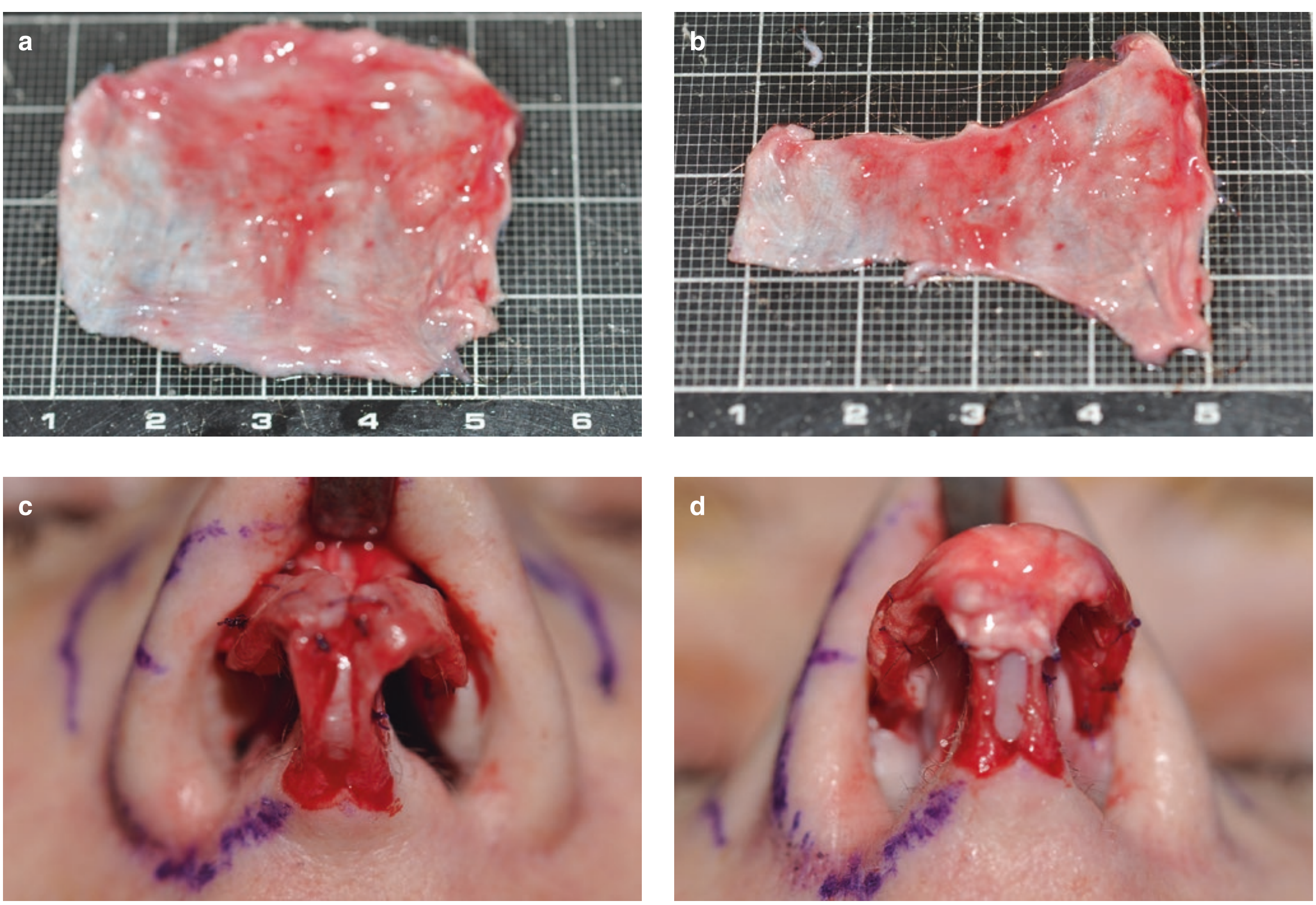


Fig. 1.32 (**a–d**) Preparation and insertion of deep temporal fascia graft

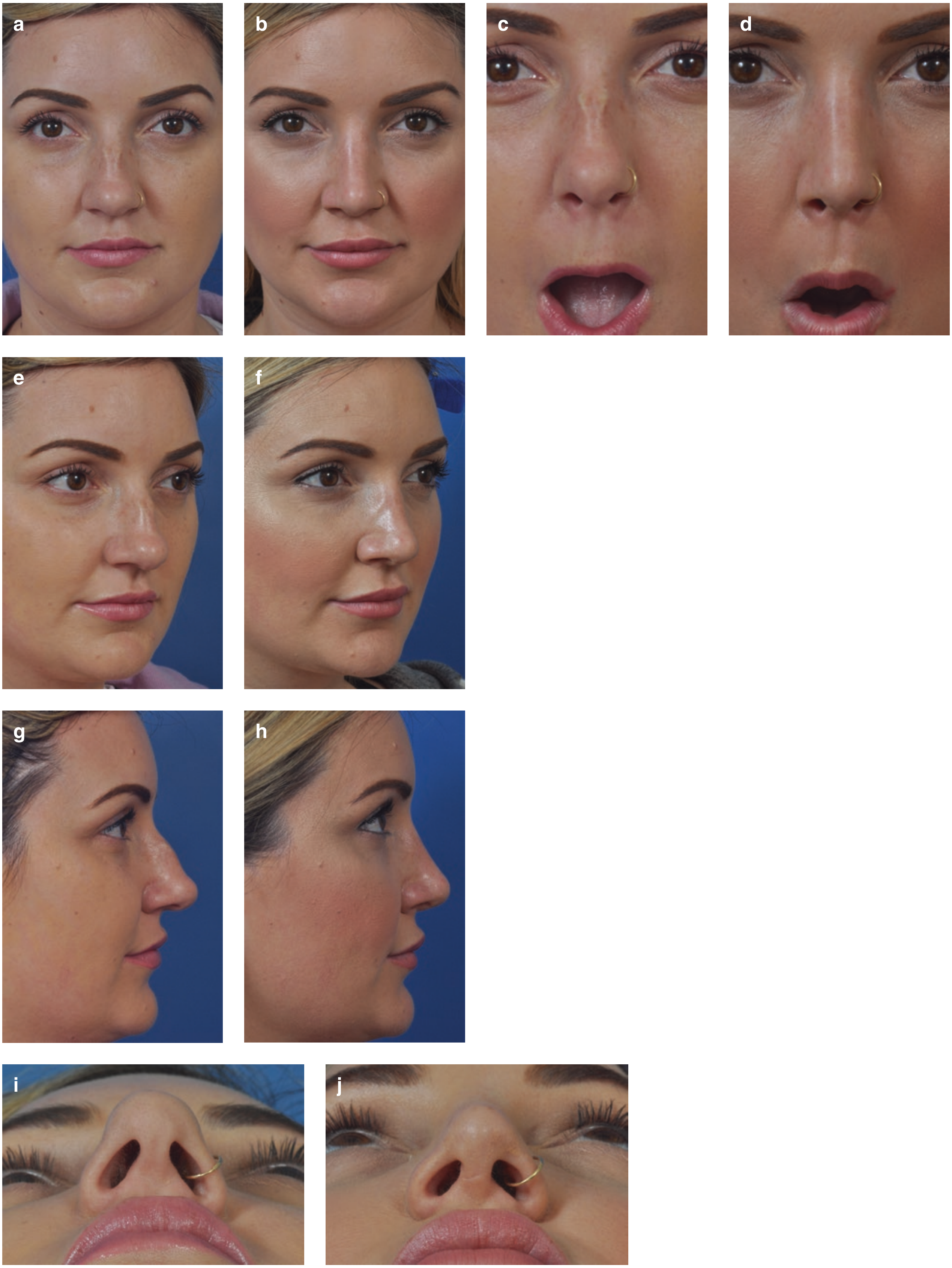


Fig. 1.33 (**a–j**) Case study patient before (*left*) and 1 year after (*right*) treatment

INTERDOMAL LIGAMENT

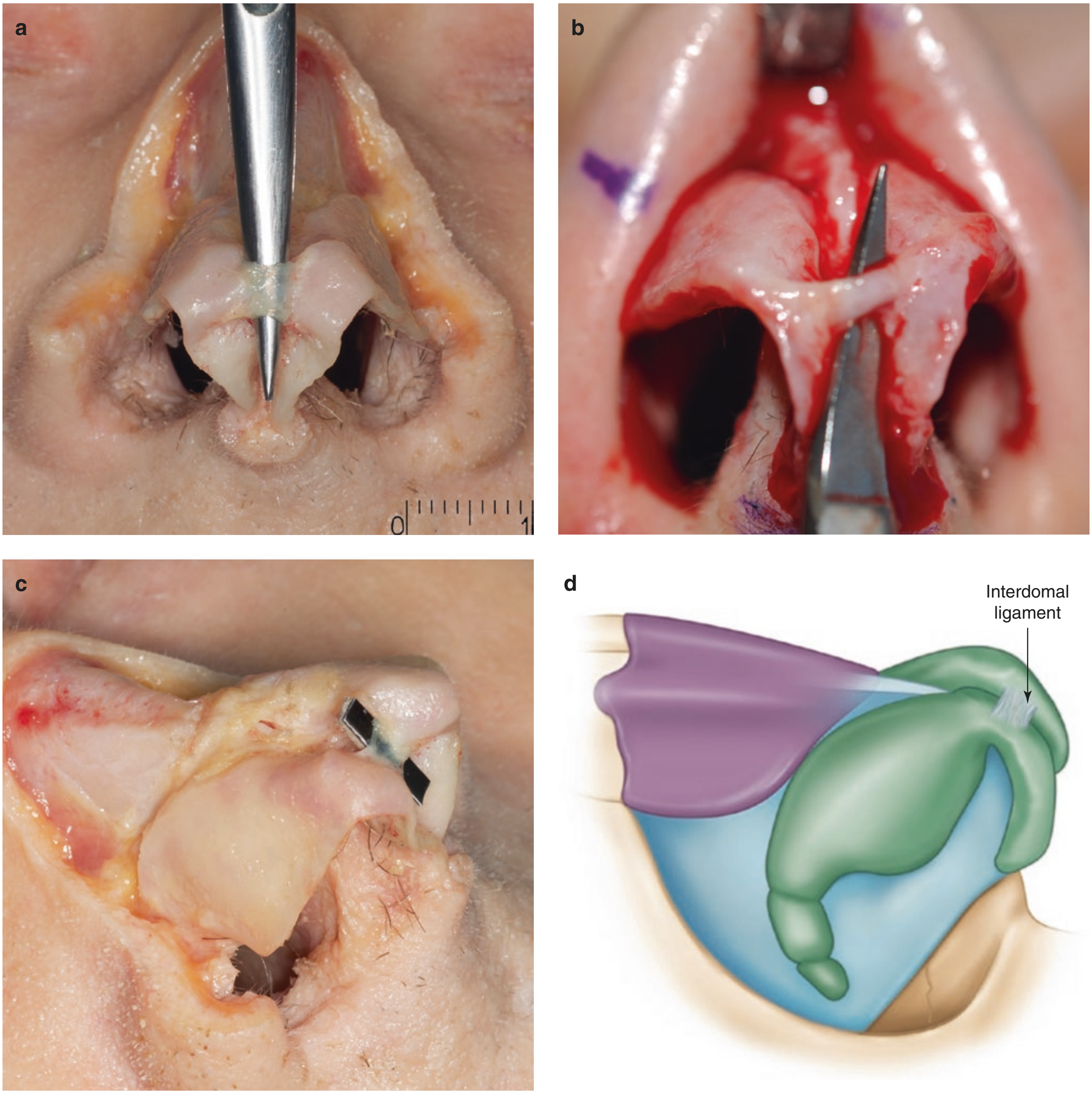


Fig. 1.34 (**a**–**d**) Interdomal ligament anatomically and clinically

The anatomical term “ligament” is defined in *Terminologia Anatomica* as “a band or sheet of fibrous tissue connecting two or more bones, cartilages or other structures….” This broad definition can result in the identification of a large number of ligaments. This section reviews the most commonly accepted ligaments and discusses their surgical relevance.

The ***interdomal ligament*** connects the two middle crura at the cephalic junction of the infralobular segment (Fig. 1.34). Technically, the ligament does not run between the domes, but rather more posteriorly and cephalically between the middle crus. It is easily found in all noses and is quite rigid. Although many surgeons cut it during insertion of a columellar strut, the interdomal ligament can easily be preserved owing to its cephalic postion away from the caudal border of the middle crura. Obviously, this preservaton is not possible if a “tip split” procedure is done.

INTERCRURAL LIGAMENT

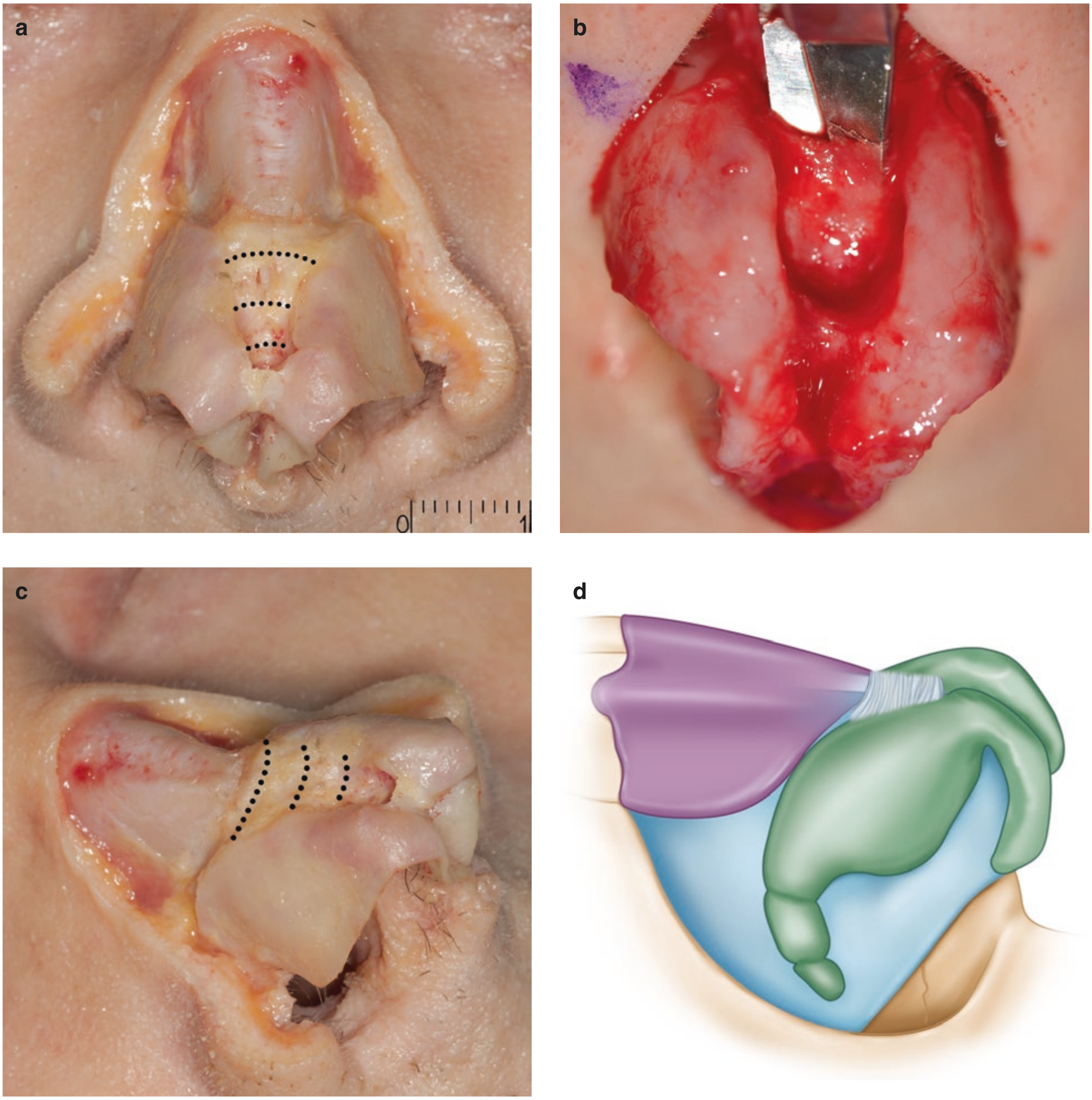


Fig. 1.35 (**a–d**) Intercrural ligament connects the *medial border* of the alar cartilages throughout their length

The *intercrural ligament* connects the cephalic border of the entire alar cartilages including the lateral, middle, and medial crus (Fig. 1.35). It passes just above the mucosa and holds the alar cartilages together. In its cephalic portion along the lateral crus, it acts as the suspensory ligament of Converse, passing just above the anterior septal angle (Converse 1977). In its mid portion, it is posterior to the interdomal ligament. Its caudal component effectively restrains the medial crura and footplates, pulling them towards the caudal septum. Effectively, the intercrural ligament unifies the two alar cartilages and acts as a suspensory sling over the anterior septum. During rhinoplasty surgery, this ligament can either be preserved or easily disrupted. In an open approach, a "tip split" procedure as opposed to a "dorsal split" will divide the ligament and require the surgeon to restore support, usually with a columellar strut. A bilateral transfixion incision through the membranous septum will disrupt the intercrural ligament support between the footplates and the caudal septum. It may be necessary to insert a septocolumellar suture to regain this support.

PITANGUY'S MIDLINE LIGAMENT

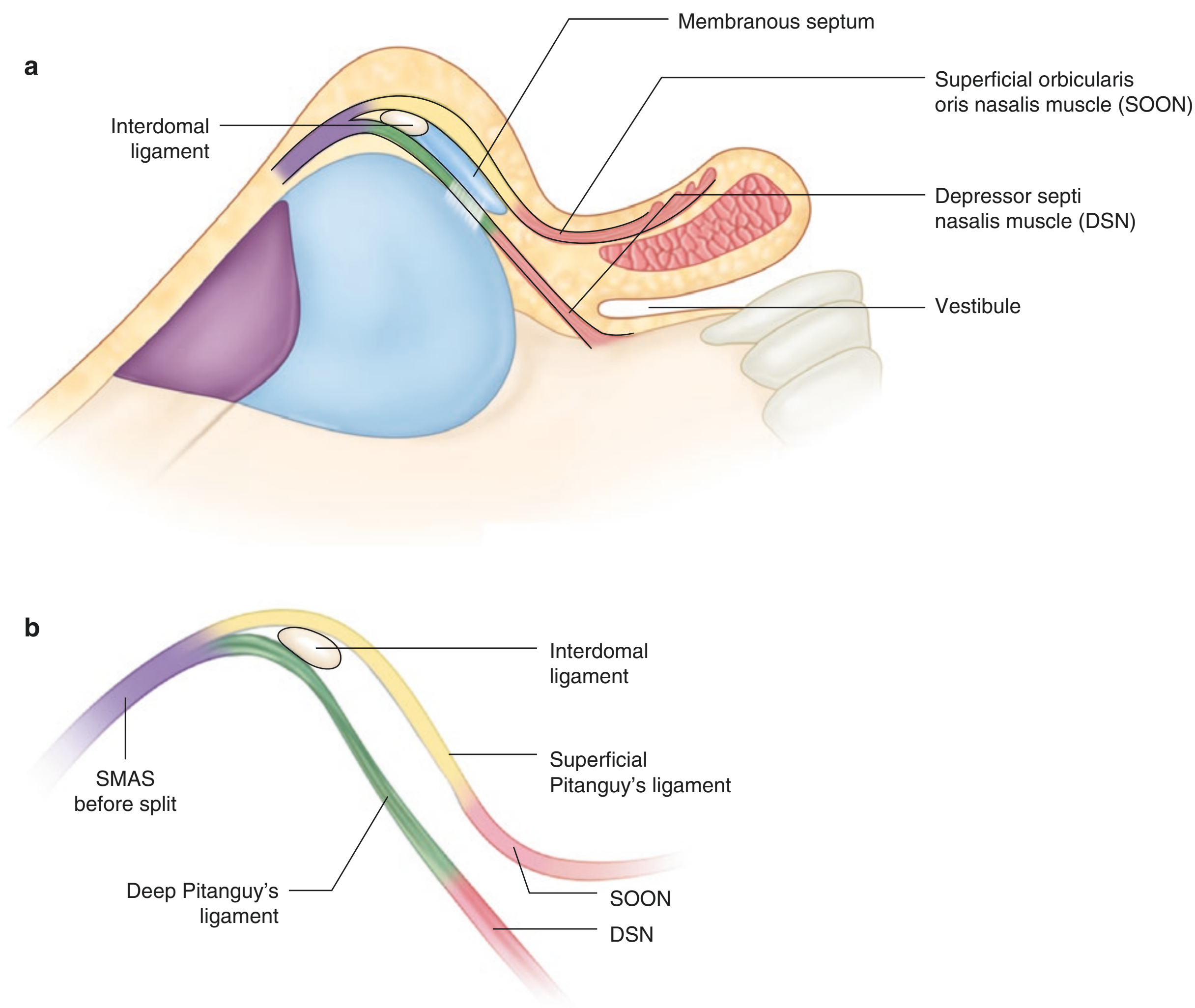


Fig. 1.36 (**a**–**b**) Pitanguy's midline ligament

Pitanguy (1965, 2001) described a ligament originating on the undersurface of the dermis and running tangentially down to and between the alar cartilages (Fig. 1.36). He reported a connection between this ligament and the depressor septi nasi (DSN), which was later confirmed by de Souza Pinto et al. (1998). Recently, Saban and Polselli (2009) have demonstrated that the medial SMAS at the level of the internal nasal valve divides into a superficial and a deep layer. The **superficial medial layer** runs caudally below the interdomal fat pad, but above the interdomal ligament into the columella. The **deep medial layer** of the SMAS runs beneath the interdomal ligament, but above the anterior septal angle into the membranous septum and then downward toward the anterior nasal spine. Saban et al. (2008) concluded that the deep medial SMAS could correspond to Pitanguy's ligament. Based on the accepted five-layer laminate concept of the nasal STE, Pitanguy's ligament cannot be a true dermocartilaginous ligament, as it would violate this concept. To acknowledge the contributions of Pitanguy, we will use the term ***Pitanguy's midline ligament*** (Çakir et al. 2012). Our dissections confirm these prior observations but emphasize that the connection is between the DSN and the deep medial SMAS, which passes beneath the interdomal ligament (Daniel et al. 2013). This midline ligament is a distinct tether that allows the tip to be pulled down by muscle contracture.

PITANGUY'S MIDLINE LIGAMENT

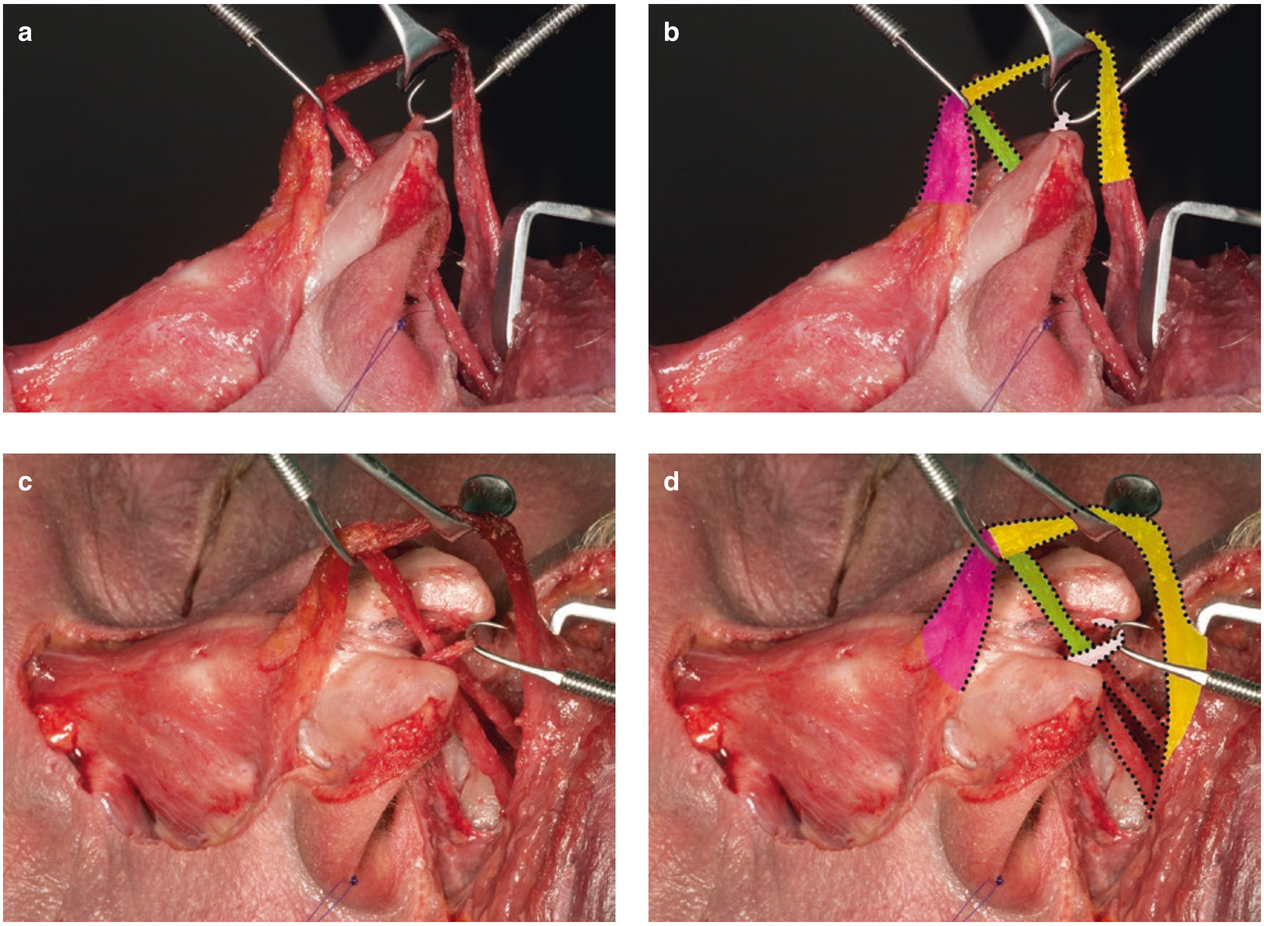


Fig. 1.37 (**a–d**) Pitanguy's midline ligament

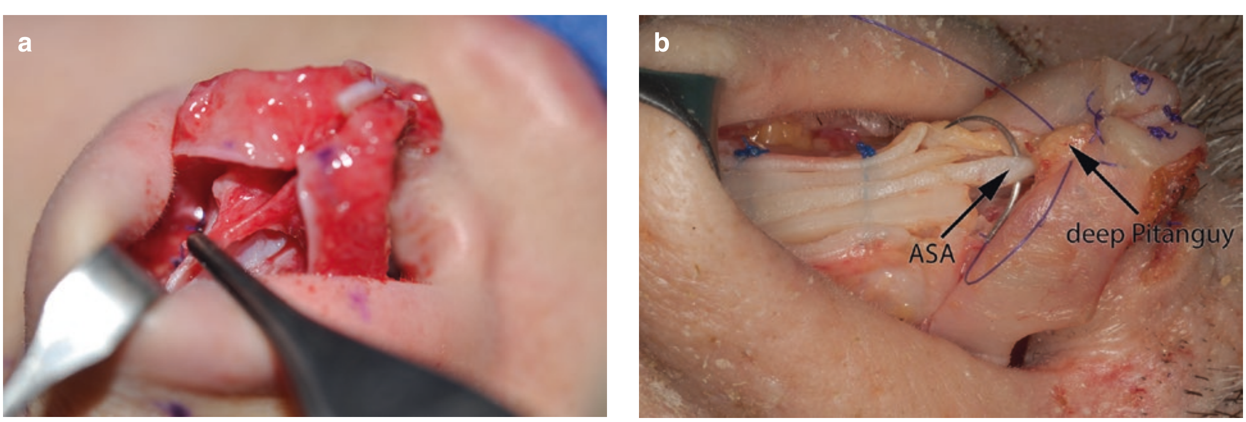


Fig. 1.38 Tip position suture. (**a**) Deep Pitanguy's ligament is pulled cephalically. (**b**) Deep Pitanguy's ligament is sutured for tip positioning. *ASA* anterior septal angle

Surgically, division and repair of Pitanguy's ligament has become an important method of supporting the nasal tip (Fig. 1.37). Utilizing a closed approach, Çakir (2016) identifies the ligament, marks, divides, and then repairs Pitanguy's midline ligament. He feels that this method allows him to ensure long-term tip support. In our patients with thick skin, we often excise the SMAS tissue in the supratip region to reduce the bulk of the STE. Once the tip suturing is completed, we often use a tip position suture to rotate and support the tip. The suture passes from the deep SMAS of Pitanguy's midline ligament to the dorsal septum near the anterior septal angle (ASA), thus using the ligament as a tether to control tip position (Fig. 1.38).

FOOTPLATE SLING AND COLUMELLAR BASE

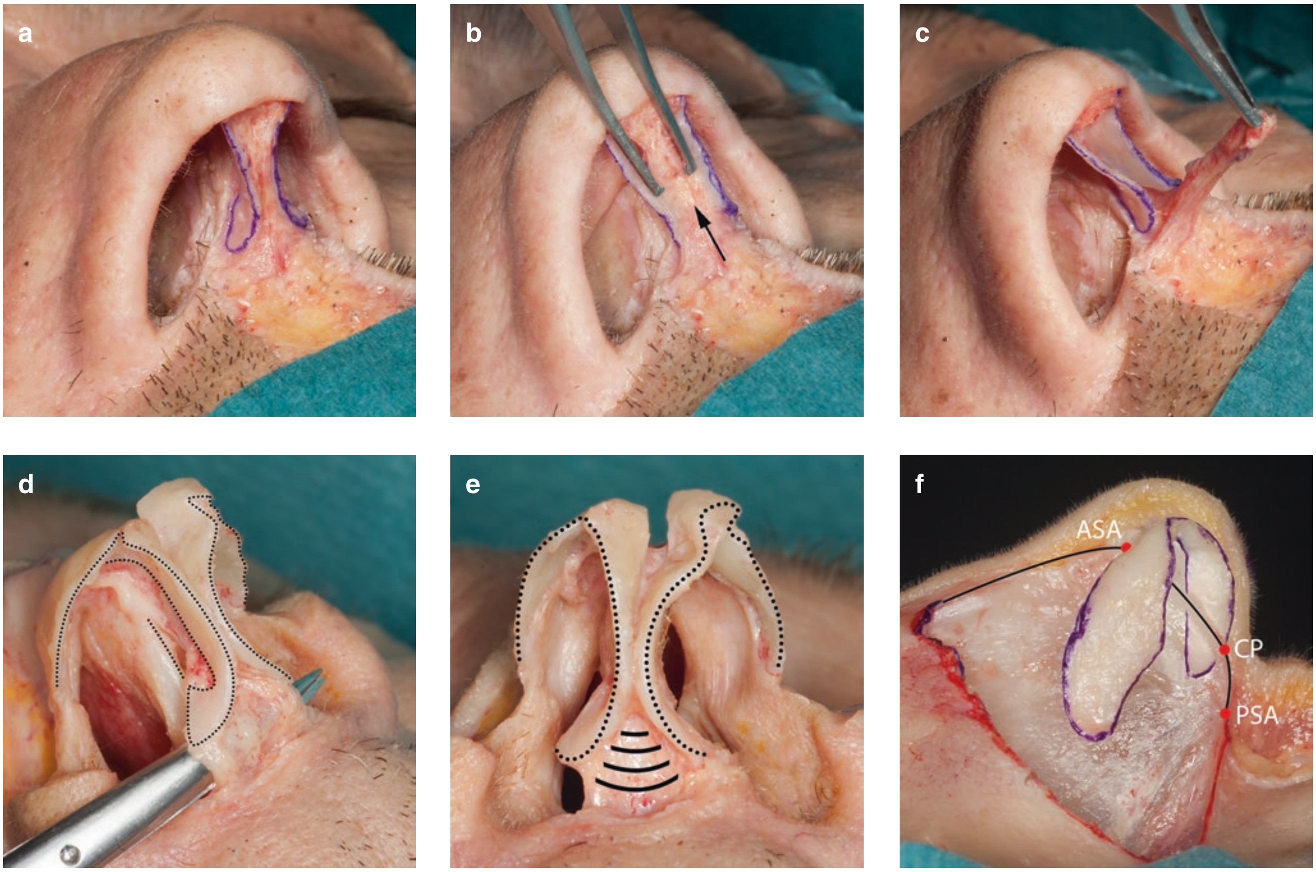


Fig. 1.39 (**a**–**c**) Superficial orbicularis oris nasalis (SOON) creates the tissue between the medial crura, which connects them loosely. (**d**, **e**) After removing the SOON, the deep Pitanguy's ligament (from depressor septi nasalis) can be seen embedded in the membranous septum. At this stage, one can see a more obvious *footplate sling* structure between the footplates. (**f**) The *footplate sling* slips on the caudal point (CP) of the caudal septum while providing support to the nasal tip

In their classic study of nasal tip support, Janeke and Wright (1971) listed the junction of the medial crura and caudal septum as one of the four pillars of nasal tip support. Tardy and Brown (1990) considered it one of the three major tip support mechanisms. Subsequently, Gunter et al. (1988) diagrammed these as a distinct fibrous attachment between the footplates and the caudal septum. Multiple dissections have failed to identify any distinct *footplate ligament* between the footplates and the caudal septum. Clinically, one only has to pull on one's own columellar to note its mobility and the absence of a restraining ligament. Our conclusion is that there are two components to the relationship between the medial crus and the caudal septum. First, the intercrural ligament acts as a suspensory ligament for the entire alar cartilage complex over the dorsal and caudal septum. Second, there is a transverse *footplate sling* between the footplate segments of the medial crura. The tissue of this sling is composed of the SOON and the deep Pitanguy's ligament. This sling wraps around the caudal septum in a caudal-to-cephalic direction, while it rests upon the caudal point (CP) of the caudal septum and the soft tissue in the columellar base (Fig. 1.39).

PYRIFORM LIGAMENT

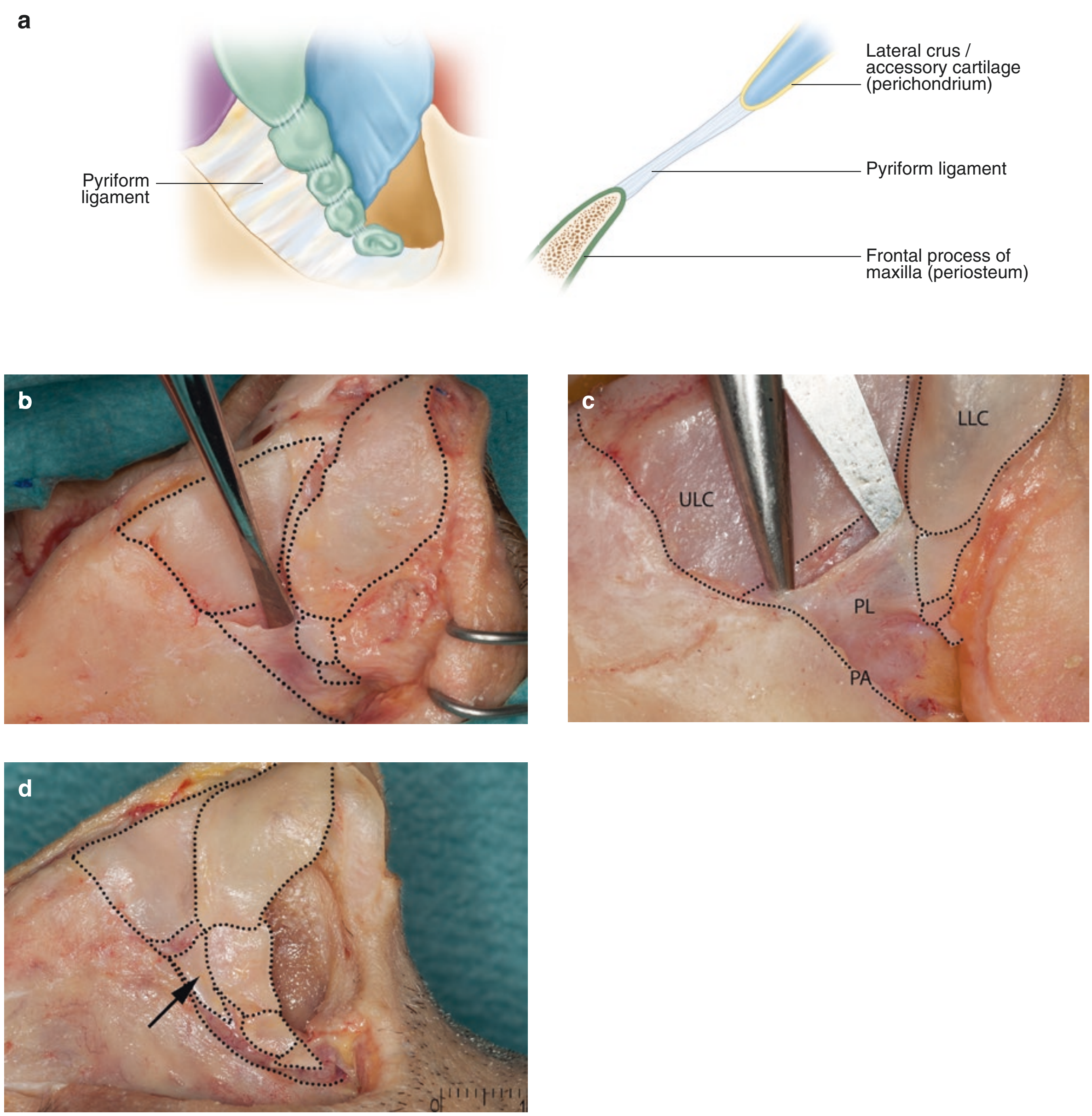


Fig. 1.40 (**a**) Fusion of the perichondrium and periosteum creates the pyriform ligament (PL). (**b**, **c**) The PL overlays the mucosal space. (**d**) It sometimes contains interspersed sesamoid cartilage (*arrow*). *LLC* lower lateral cartilage; *PA* pyriform aperture; *ULC* upper lateral cartilage

Numerous surgeons have described a narrow, circular, fibrous attachment beginning at the lateral crus, incorporating the accessory cartilages, and then attaching to the pyriform aperture, but it was Rohrich et al. (2008) who emphasized the more general concept of a pyriform ligament. They found a broad ligament between the bones of the pyriform aperture and the adjacent cartilages. Although the purpose of their study was to describe the static ligamentous connections of the alar base, it was obvious that the pyriform ligament runs in too deep a plane and has no direct connection to the alar base. The ***pyriform ligament*** is probably a vestigial ligamentous sheet left over from absorption of the cartilaginous capsule between the periosteum of the bony pyriform aperture and the perichondrium of the adjacent cartilages. Despite the advocates of the tripod concept, this ligament does not provide structural support to the tip, but it does reinforce the mucosal space. As surgeons have sought total exposure of the bony vault for piezoelectric surgery, it has become necessary to cut a portion of this ligament (Fig. 1.40).

LONGITUDINAL SCROLL LIGAMENT

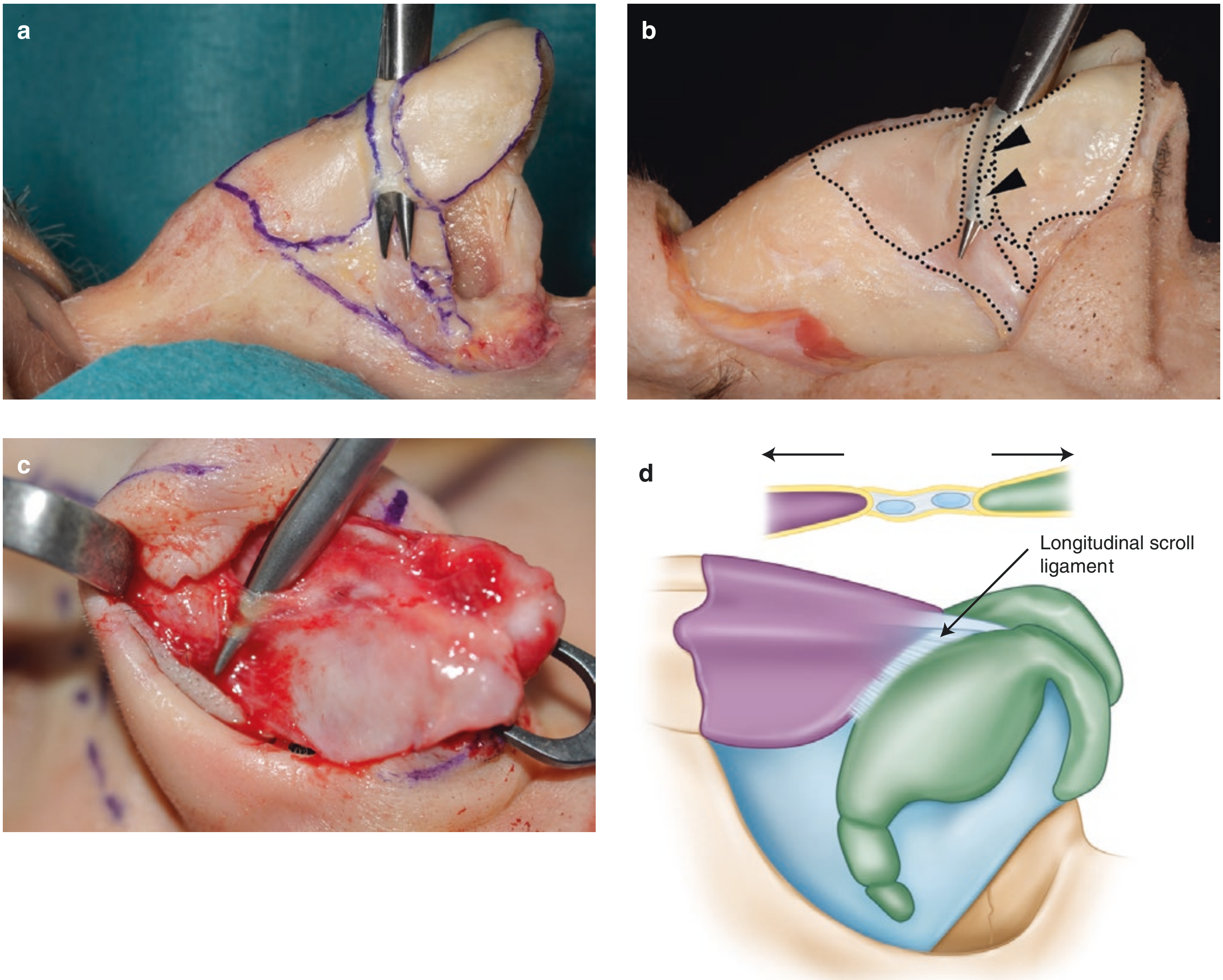


Fig. 1.41 Longitudinal scroll ligament (LSL) (**a**) without and (**b**) with interspersed scroll cartilages (*arrowheads*). (**c**) LSL clinically. (**d**) LSL connects the lateral crus to the upper lateral cartilage

A longitudinal fibrous attachment has long been recognized at the scroll area between the cephalic border of the lower lateral cartilages (LLCs) and the caudal border of the upper lateral cartilages (ULCs) (Drumheller 1973). Recently, Saban et al. (2008) has identified a distinct fibrous attachment from the undersurface of the transverse nasalis muscles to the scroll junction. Thus, we now have a ***longitudinal scroll ligament*** and a ***vertical scroll ligament***, each with clinical significance. The longitudinal scroll ligament is a component of the" scroll complex." Anatomical studies show that the junction between the LLC and ULC has interspersed sesamoid cartilages within the fibrous tissue. Preservation of this ligament can be achieved by maintaining the cephalic lateral crus. Alternatively, one can do a "cephalic preservation" as recommended by Gruber et al. (2010), in which suturing of the divided lateral crus restores structural integrity. When the longitudinal scroll ligament is divided via an intercartilaginous incision, Çakir (2016) repairs it with two interrupted sutures (Fig. 1.41).

VERTICAL SCROLL LIGAMENT AND VERTICAL PYRIFORM ATTACHMENT

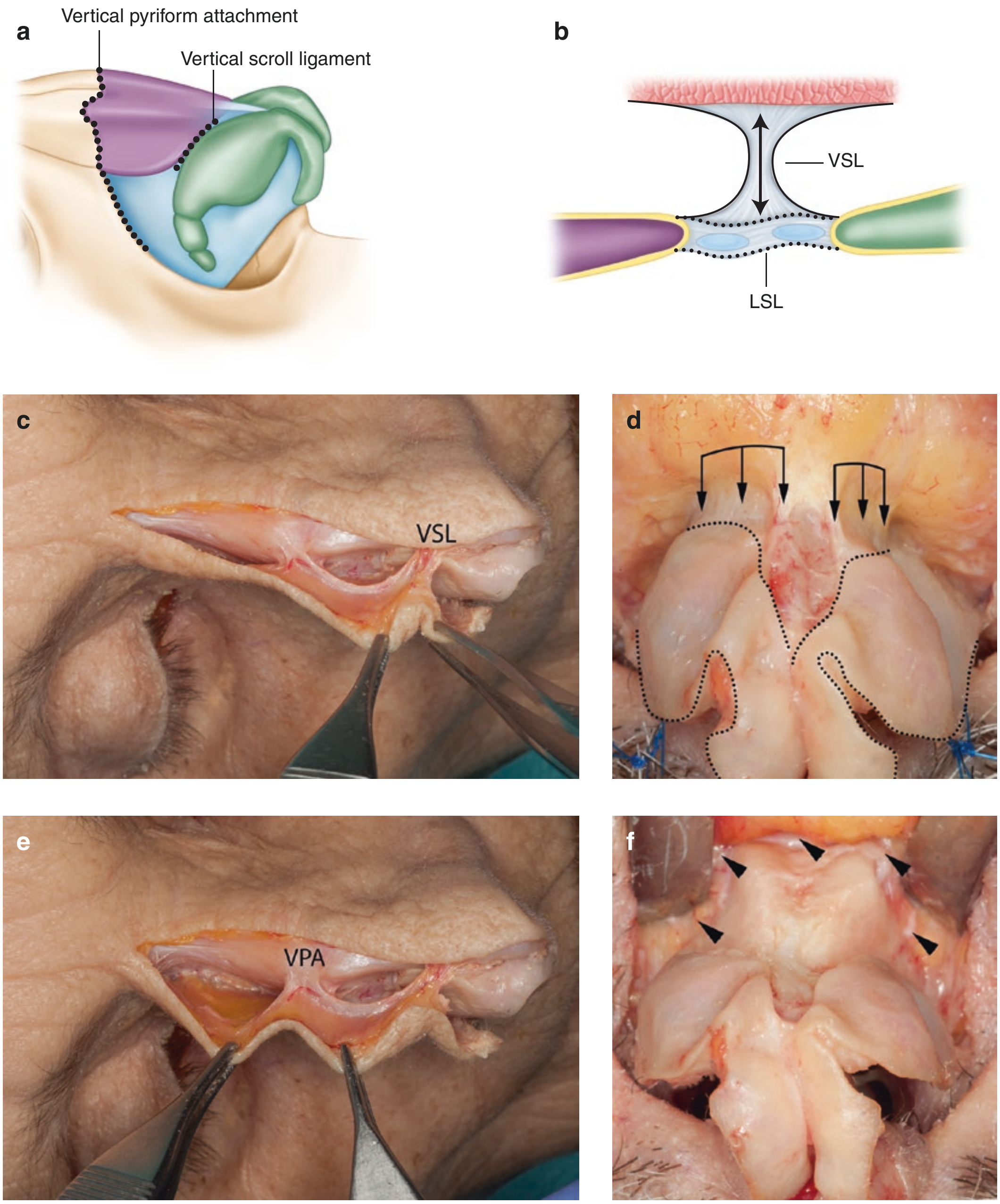


Fig. 1.42 (**a–f**) Vertical scroll ligament (VSL) and the vertical pyriform attachments (VPA)

Saban et al. (2008) introduced the concept of a vertical scroll ligament that emerges from the undersurface of the deep SMAS layer and inserts into the internal nasal valve area. Clinically, the presence of this ligament is confirmed when one dissects in the subperichondrial plane over the lateral crus and tries to continue onto the ULC. A very dense ligamentous band is encountered, which prevents dissection in continuity. Saban (2009) also noted distinct superior and inferior lateral nasal ligaments along the pyriform aperture. We have found these ligaments to be inconsistent as distinct entities, but have found a consistent vertical attachment along the entire pyriform aperture and the overlying STE. It is particularly dense over the keystone area and occasionally along the lateral border. Release of this vertical pyriform ligament has become important in the total dorsal exposure associated with complete lateral osteotomies done with a piezoelectric saw (Gerbault et al. 2016) (Fig. 1.42).

TIP SUPPORT

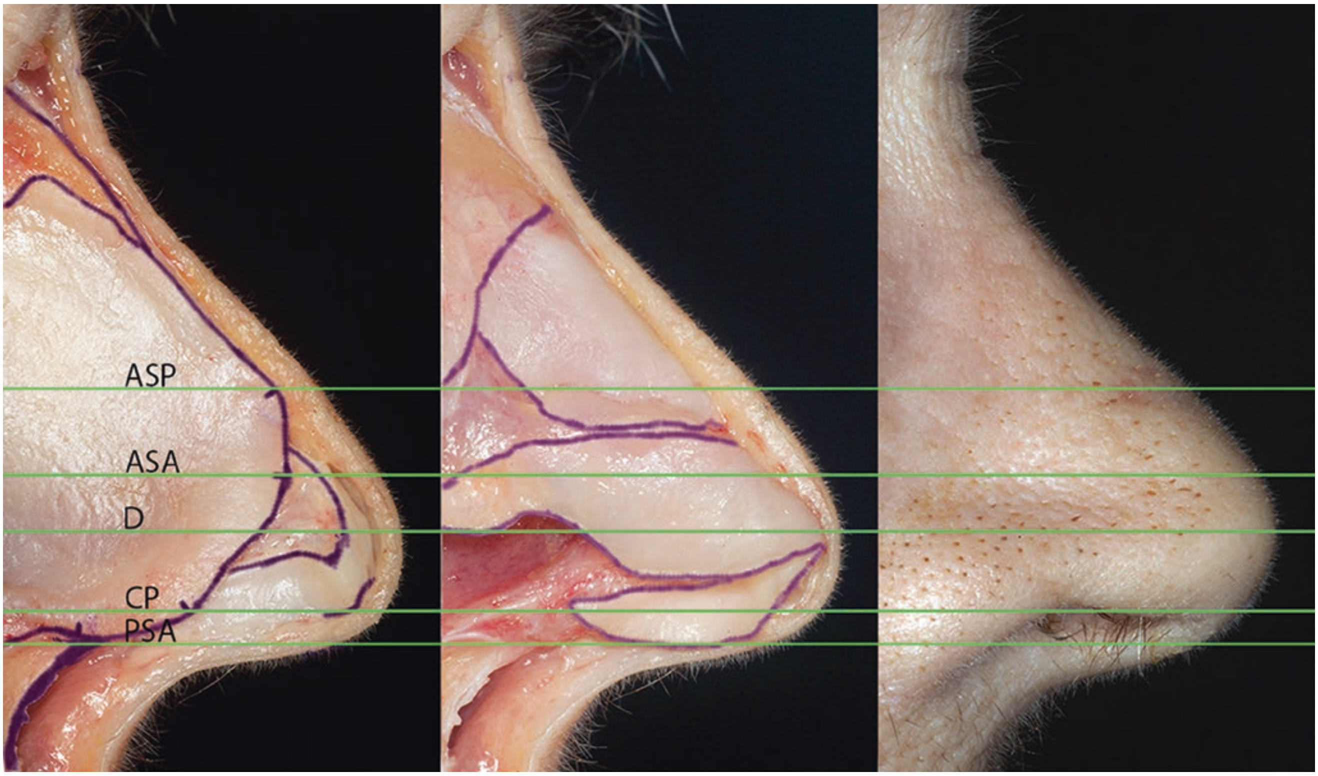


Fig. 1.43 Relationship of the tip-defining point and cartilaginous landmarks: anterior septal point (ASP), anterior septal angle (ASA), dome (D), caudal point (CP), posterior septal angle (PSA)

Why are rhinoplasty surgeons obsessed with tip support? As succinctly summarized by Janeke and Wright (1971), "Postoperative sagging of the nasal tip is an annoying and too frequent complication of rhinoplasty. The present anatomical investigation was instituted to clarify some of the factors involved in this problem." Almost 50 years later, rhinoplasty surgeons are finally understanding the nasal ligaments and how to preserve or repair them in order to maintain tip support. Another source of tip support is cartilaginous, consisting of the anterior septum, and specifically the relationship of the ASA to the domes. As stated by Bitik et al. (2015), "In the normal nasal anatomy, an anterior septal angle of sufficient height keeps the feet of the medial crura off the anterior nasal spine; the medial crura do not bear a significant load…." Constantian (2004) considers the relationship of the ASA to the tip the cardinal point in planning and performing tip surgery. Yet what is the anatomical relationship between the dorsal septum and the alar cartilages? Our studies indicate that four landmark points must be defined (Fig. 1.43). The *anterior septal prominence (ASP)* is the most projecting point on the dorsal septum. Its location may range from the ASA to the keystone area, depending on the patient's dorsal hump. The *anterior septal angle (ASA)* is a term commonly used but rarely defined. The consensus is that it represents the junction between the dorsal and caudal septum. The *caudal point (CP)* is the most caudal portion of the caudal septum. The *posterior septal angle (PSA)* is the junction between the caudal septal cartilage and the bony anterior nasal spine. Thus, the dilemma is whether to depend on the "judgment call" of locating the ASA or the anatomical certainty of locating the PSA.

TIP SUPPORT

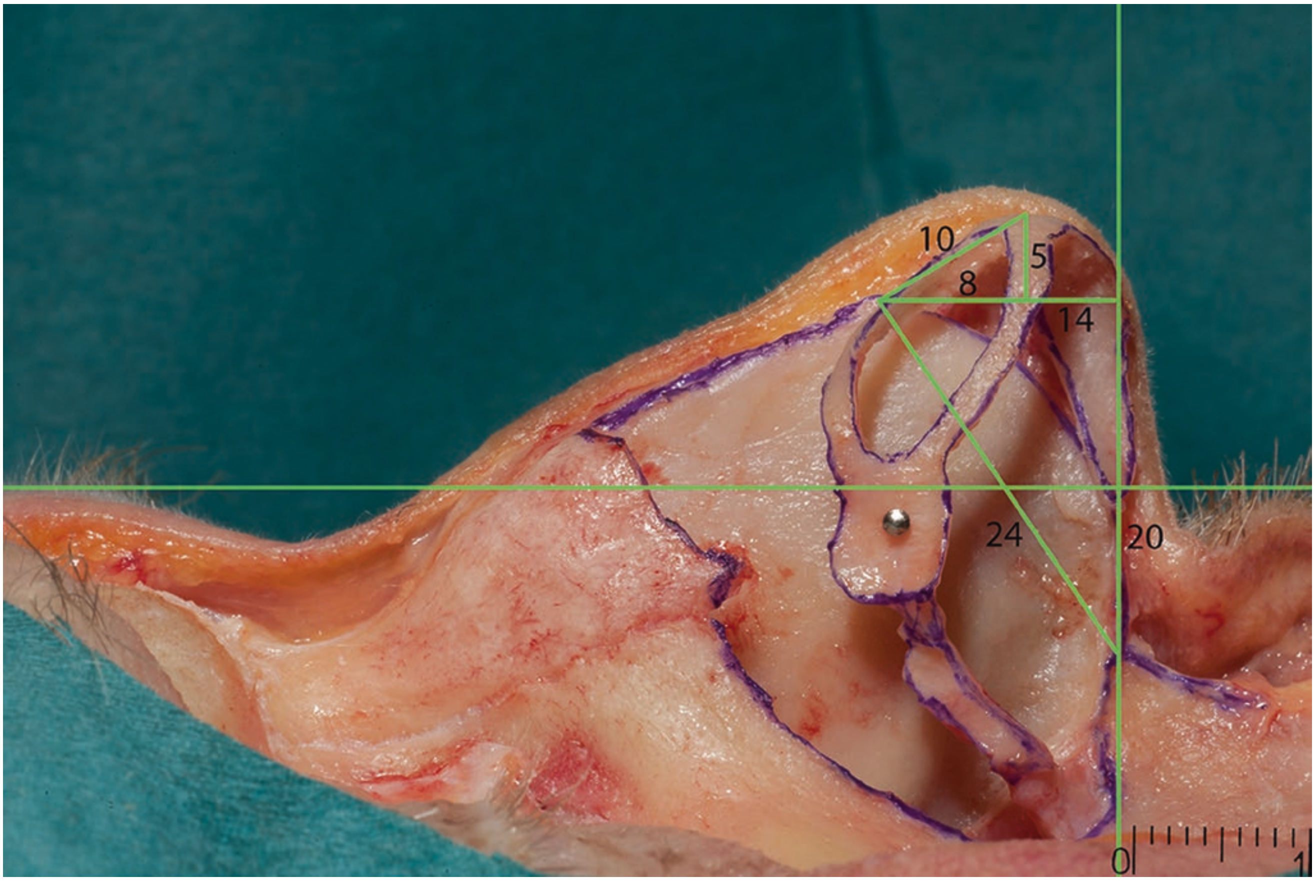


Fig. 1.44 Anterior septal angle and dome relationship

We studied 15 fresh cadavers and found the following relationship between the domes and ASA (Fig. 1.44). The domes were projected an average of 5.7 mm (2.2–9.6 mm) above the ASA and were longitudinally 5.5 mm (2.9–9.5 mm) caudal to the ASA (Daniel and Palhazi 2018). Thus, there was no direct support from the ASA to the domes. From these dissections, we have concluded that the suspensory ligaments of the nasal tip are important in tethering the dynamic mobile alar cartilages to the abutting cartilaginous framework. Traditionally, many surgeons have favored "Anderson's tripod concept" of the alar cartilages as a method of analyzing tip surgery. In contrast, we propose a more dynamic concept of the tip and tip surgery. It begins with the intrinsic integrity of the alar cartilages, which are held together by ligaments (intercrural, interdomal). These cartilages are then encased in the nasal SMAS, which attaches through insertions (vertical scroll ligament) and even muscle origins (anterior dilator, compressors). Thus, the alar cartilages are controlled by the SMAS and act as a dynamic structure that abuts the cartilaginous framework. For too long, rhinoplasty surgeons have seen the nasal tip as a fixed, static pair of alar cartilages with a tripod support. Our dissections indicate that there is no direct support; instead, the alar cartilages are dynamically mobile, and surgically we have the option of positioning the tip by pulling on the suspensory ligaments.

CLOSED RHINOPLASTY AND LIGAMENT REPAIR: CASE STUDY (*COURTESY OF* DR. BARIŞ ÇAKIR)

Analysis: A 26-year-old female patient had a big nose and wanted it smaller. Her nose plunged when she smiled and the tip became rounder on side view. In cases similar to this one, the soft tissue excess must be controlled and the surgeon must avoid a supratip deformity, which is quite common in reduction rhinoplasty.

Operative Technique:

1. Caudal transseptal incision and caudal septal resection.
2. Marginal incision for delivery of the domes.
3. Subperichondrial and subperiosteal dissection (Fig. 1.45a, b) (Note clean subperichondrial dissection.)
4. 3-mm cephalic lateral crural strip excision.
5. 3-mm lateral crural steal and cephalic dome suture to correct the lateral crural resting angle.
6. Columellar strut graft insertion.
7. Hump reduction, lateral and transverse osteotomies; then "Libra graft" used for mid-vault reconstruction.
8. Columellar cartilage strip sutured to the septum.
9. Pitanguy's ligament was kept intact (Fig. 1.45c) and the vertical scroll ligament was repaired (Fig. 1.45d).

Commentary: Skin envelope redraping is important after significant reduction of the nasal skeleton. The nasal SMAS loses two important insertion points through Pitanguy's ligament and the vertical scroll ligament. Reducing the size of the nose leads to skin envelope bulging in the supratip and scroll area. Preserving the continuity of Pitanguy's ligament and repairing the vertical scroll ligament controls skin redraping (Fig. 1.46).

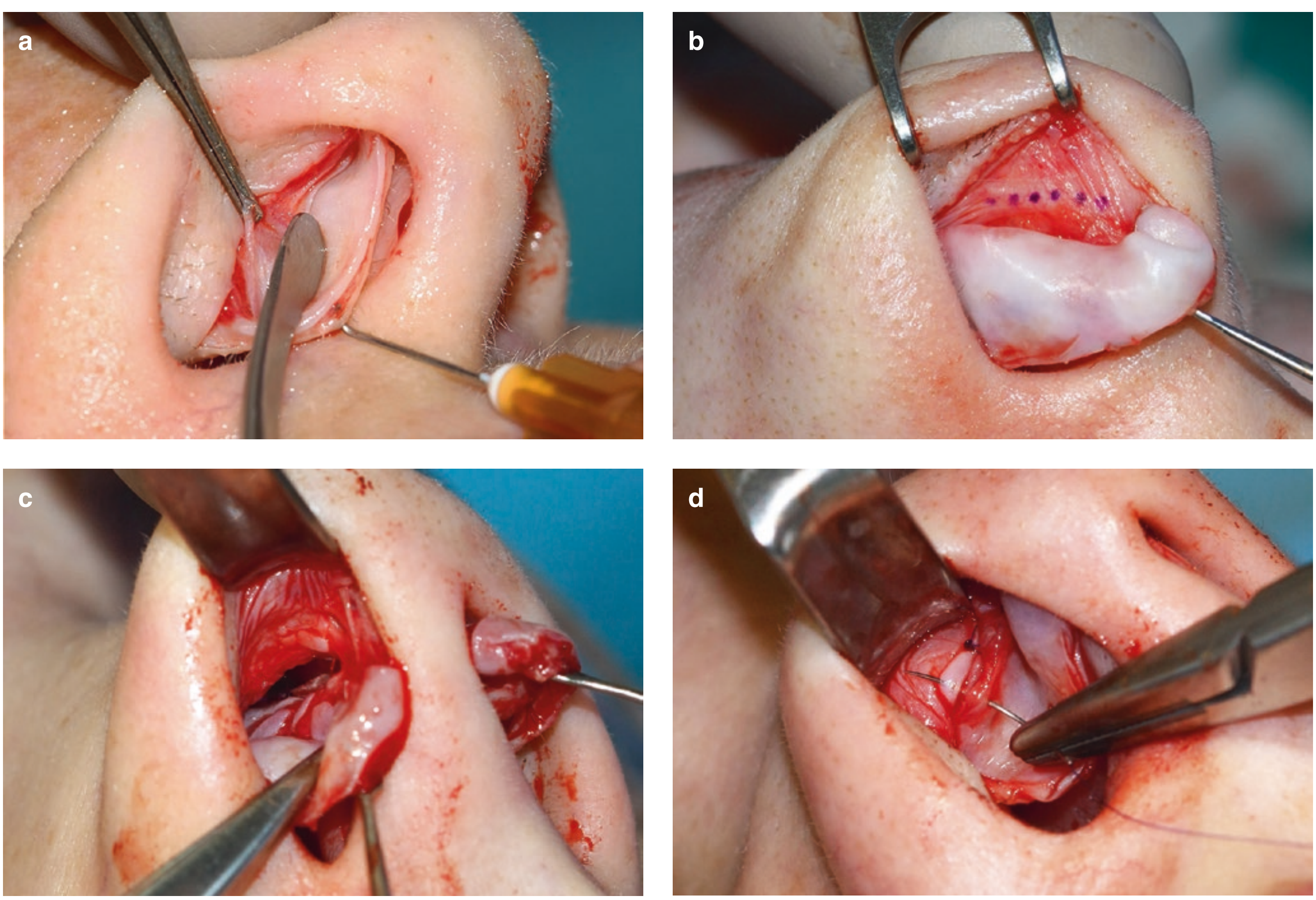


Fig. 1.45 Closed rhinoplasty and ligament repair. (**a**) Subperichondrial dissection. (**b**) Incision line of the vertical scroll ligament. (**c**) Preservation of Pitanguy's ligament. (**d**) Repair of the vertical scroll ligament

CLOSED RHINOPLASTY AND LIGAMENT REPAIR: CASE STUDY (*COURTESY OF* DR. BARIŞ ÇAKIR)

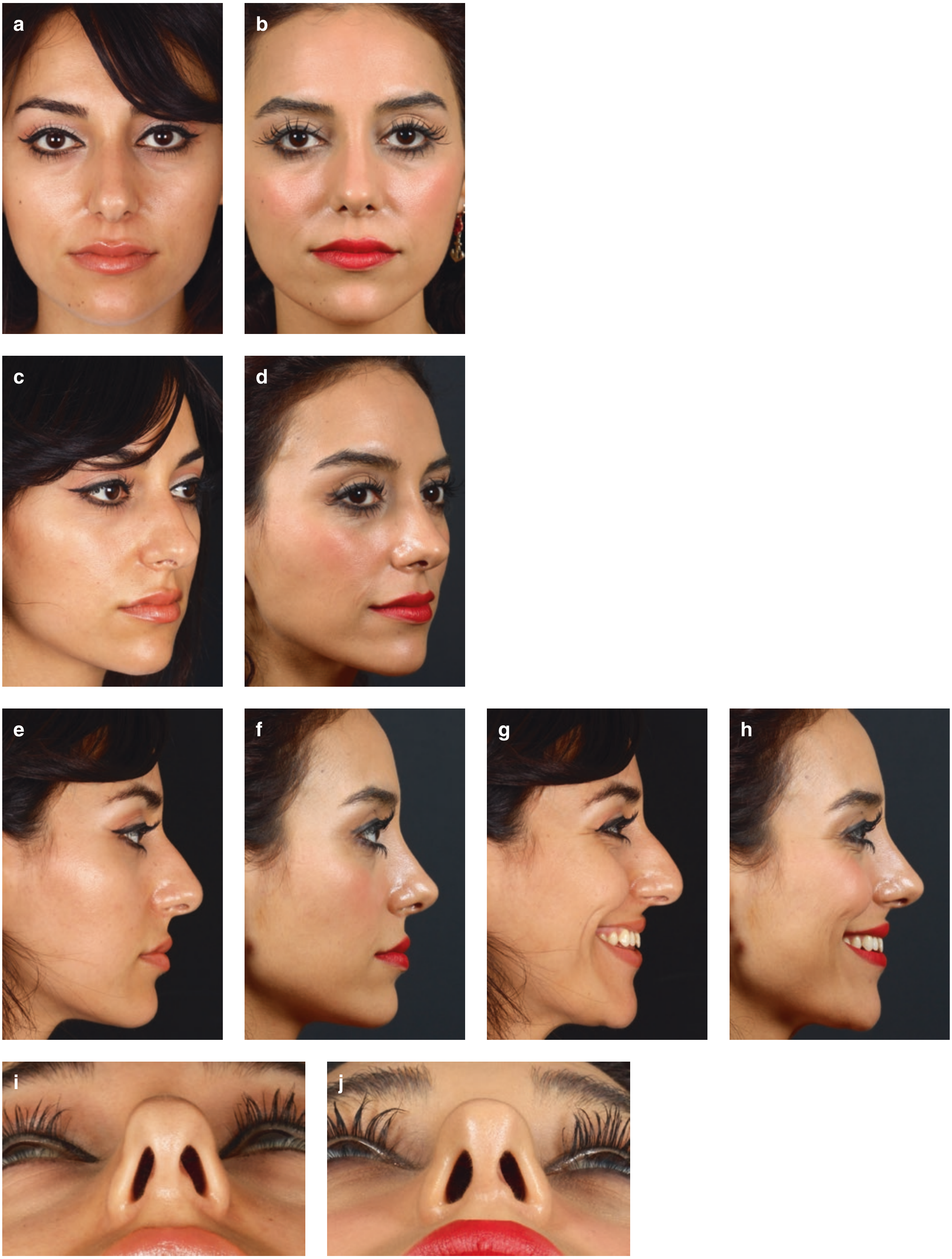


Fig. 1.46 (**a–j**) Case study patient before (*left*) and 3 years after (*right*) treatment

OPEN RHINOPLASTY WITH TIP SUPPORT: CASE STUDY

Analysis: A 30-year-old patient of Arabic descent requested a rhinoplasty. She wanted a smaller natural nose with a less bulbous tip. On examination, the tip was wide and encased in a thick skin envelope. There was little tip support, a problem that would be further compromised by dorsal reduction.

Operative Technique:

1. Harvest of a sheet of deep temporal fascia; subsequent fascia radix graft.
2. Open approach with limited defatting (Fig. 1.47a, b); rim strips reduced from 9 mm to 6 mm wide.
3. Dorsal reduction (bone 0.5 mm, cartilage 1.5 mm); 5-mm shortening of caudal septum.
4. Septal harvest; relocation of caudal septum left to right.
5. Low-to-high lateral osteotomies.
6. Columellar strut. Tip sutures: CS, DC, ID, DE, LCCS, TP. Double level domal onlay graft (Fig. 1.47c, d).
7. Nostril sill excision (R: 2.4, L: 2.8); insertion of alar rim grafts.

Commentary: At 1 year postop, the nose is smaller, more refined, and more balanced with her face. On the intraoperative photos, one can see how wide and nonsupportive the alar cartilages are, despite preservation of the interdomal ligament. The columellar strut provides vertical support, and the onlay domal graft gives greater tip definition through the thick skin (Fig. 1.48).

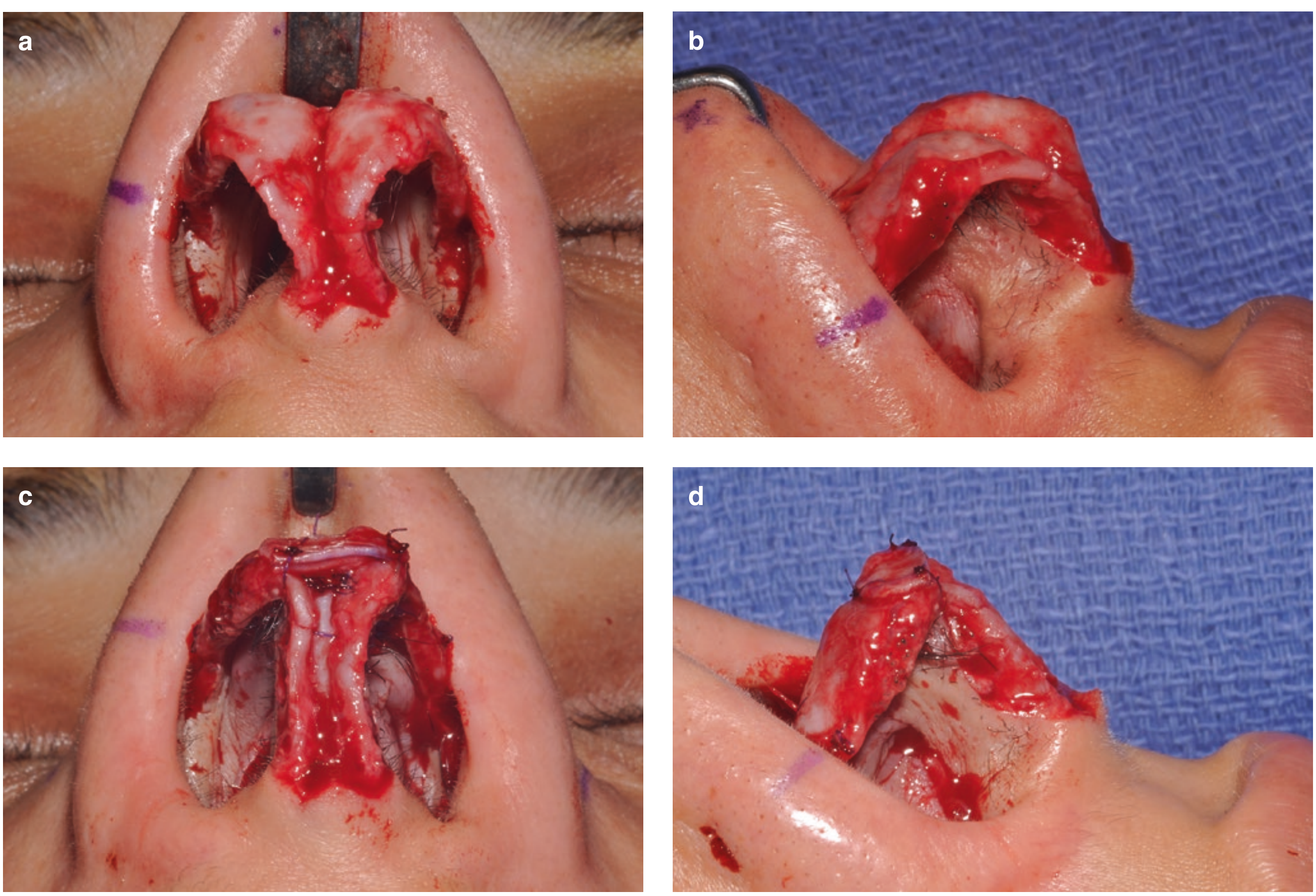


Fig. 1.47 (**a–d**) Double-level domal onlay graft

OPEN RHINOPLASTY WITH TIP SUPPORT: CASE STUDY

Fig. 1.48 (**a–j**) Case study patient before (*left*) and 1 year after (*right*) treatment

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INTRODUCTION

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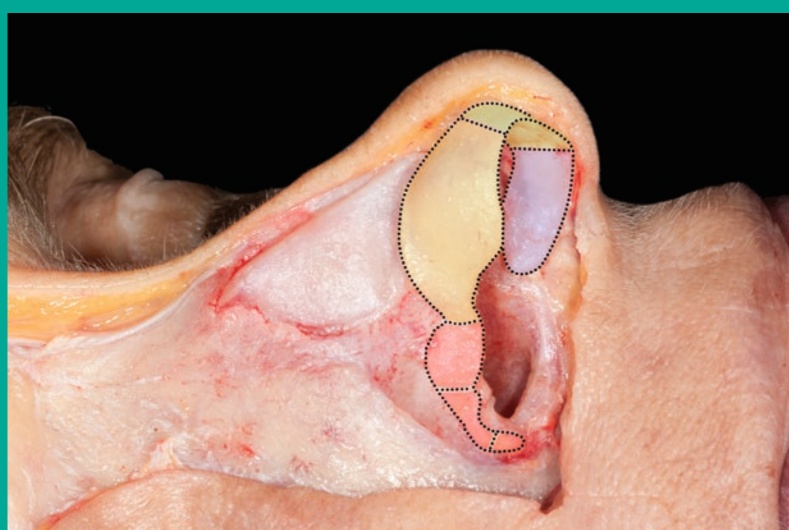
Alar Cartilages



In the sequence of surface aesthetics—anatomy—operative techniques, anatomy is at the center for a very good reason. The alar cartilage anatomy determines the surface aesthetics of the tip, and surgical techniques are performed on the anatomy to achieve the refinement that patients want. The number of surgical tip techniques has exploded in the past decade, and our concepts of tip aesthetic have also progressed. Fortunately, our knowledge of the surgical anatomy of the alar cartilages has also increased dramatically. We now know that the columella is really divided into three components: the columellar base, the footplate segment (supported by the base), and the columellar segment of the *medial crus*. The middle crus must be recognized as a distinct entity; tip asymmetry is often within the lobular segment, whereas the locus of tip suturing is the domal segment. For decades, surgeons considered the *lateral crus* as a structure to be incised or excised. Subsequently, a wide range of grafts and sutures were developed to modify the lateral crus, but more recently its preservation has become desirable. Turn-under flaps and turn-over flaps have been devised, as well as the technically demanding alar transposition procedure. Cadaver dissections have revealed the existence of the accessory cartilages and their inclusion in the *alar ring*. Functionally, rhinologists have long stated that "as the septum goes, so goes the nose," whereas rhinoplasty surgeons are very aware that "as the tip goes, so goes patient happiness." The surgeon who understands the alar anatomy will be able to execute advanced surgical techniques that produce superior results.

OVERVIEW OF ANATOMY

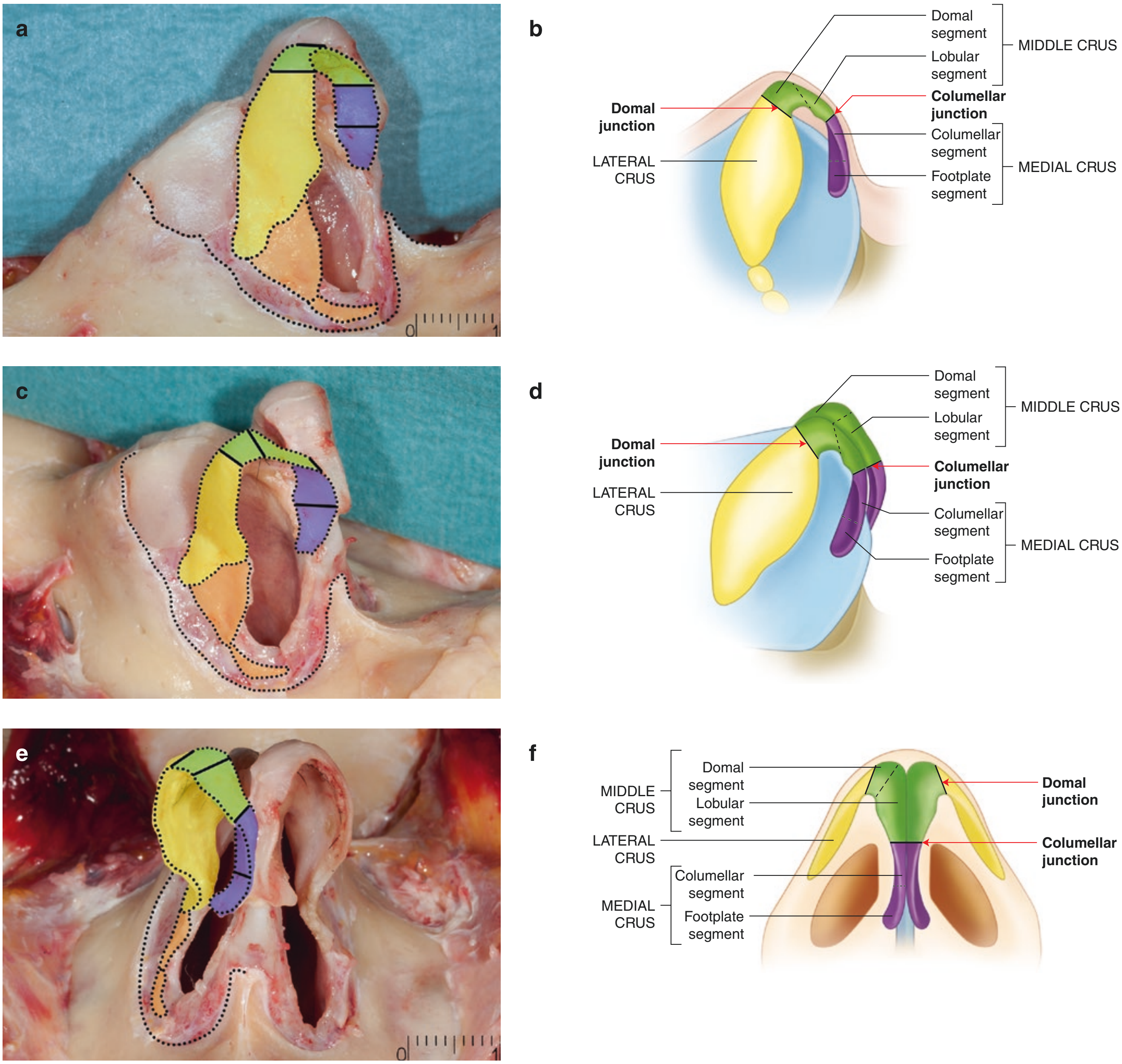


Fig. 2.1 (**a–f**) Overview of the subunits of the alar cartilage

The lower lateral cartilages can be subdivided into three portions: medial, middle, and lateral crus (Fig. 2.1) (Daniel 1992). The ***medial crus*** is the primary component of the columella and can be subdivided into the lower *footplate segment* and the superior *columellar segment*. The superior columellar segment represents the narrow waist of the columella. The ***columella-lobular junction*** (c′) occurs between the paired, vertically oriented medial crura and the divergent, angular middle crura. It is the breakpoint in the columella's "double break." It marks the transition from nasal base to tip lobule and usually corresponds with the nostril apex ±1–2 mm. The ***middle crus*** was originally defined by Sheen (1978). It begins at the columellar-lobular junction and ends at the lateral crus. It can

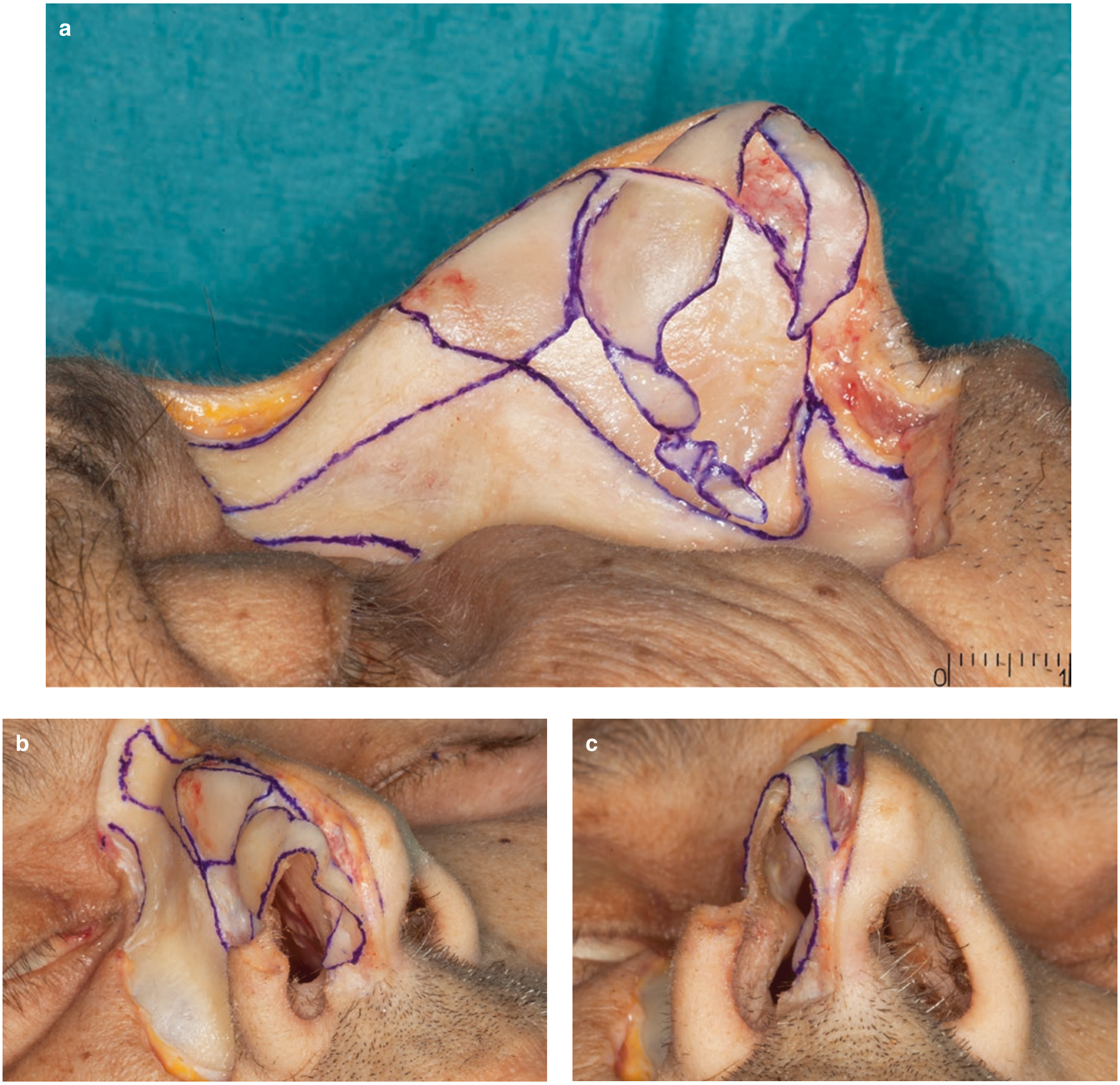


Fig. 2.2 (**a**–**c**) Position of the alar cartilage relative to the structural components of the nose

be subdivided into a *lobular segment* and a *domal segment*. The lobular segments abut in the midline at c′, but diverge towards the domes. The domal segment extends from the *medial genu*, which marks its transition with the infralobular segment, to the *lateral genu*, which marks its junction with the lateral crura. The genus bracket the *domal notch*, which in turn determines the soft triangles or soft tissue facets of the lobule. The *domal junction* is the critical landmark of the refined tip and marks the transition from middle crus to lateral crus. The tip-defining points fall consistently on the domal junction line. The ***lateral crus*** begin at the domal junction and ends at its junction with the accessory cartilages. For decades, the only question was how much cephalic lateral crus to excise to create a smaller tip, and how many weakening incisions to make in the remaining rim strip to create definition. With open tip suture techniques, it is possible to achieve tip definition without weakening the rim strip, and to control volume without excision (Fig. 2.2).

NASAL TIP: AESTHETICS (INTRINSIC)

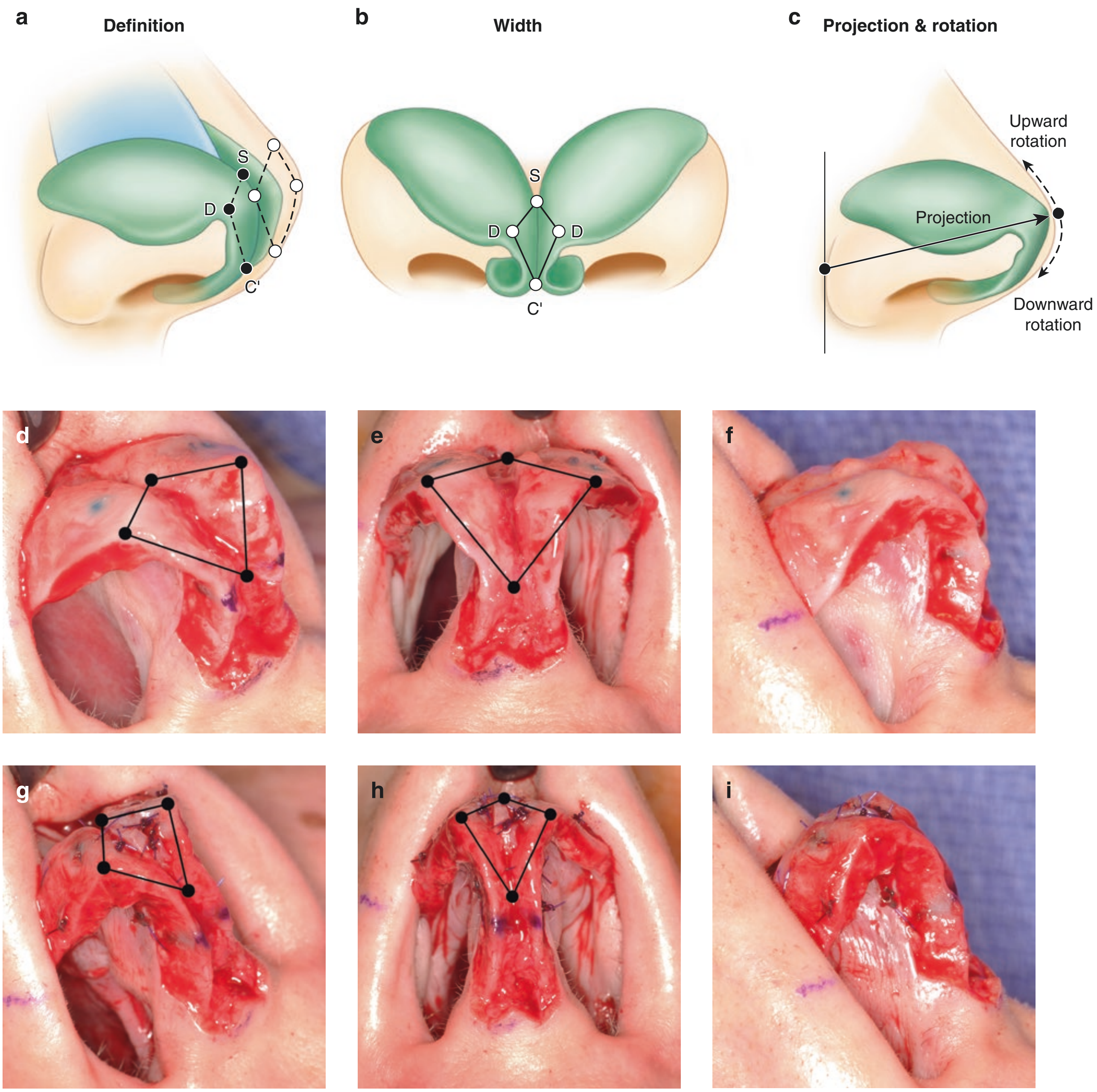


Fig. 2.3 (**a–c**) Intrinsic tip aesthetics. (**d–f**) Preoperative and, (**g–i**) postoperative intrinsic tip. AC—alar crease; c′—columellar breakpoint

The ***intrinsic*** characteristics of the nasal tip and lobule are dictated by the configuration of the alar cartilages. Sheen (1978) defined the ideal tip as having four tip points, which create a *tip diamond* (Fig. 2.3a, b). He emphasized that on the skin surface, the diamond is composed of two equilateral triangles meeting at the interdomal line. Anatomically, the tip diamond is composed of the columellar breakpoint (c′), right and left domes with the supratip breakpoint (S) a variable. The cephalic part of the domes rarely contact each other, but mark the transition to the dorsum (S). In the unoperated nose, the infralobular triangle is longer than the superior triangle. *Definition* is determined anatomically by the adjacent relationship between the *convexity* of the domal segment and the *concavity* of the lateral crus, with its surface expression revealed or obscured by the overlying skin. The anatomical configuration that correlates with the best tip definition is a convex domal segment with an adjacent concave lateral crus. The critical importance of the skin envelope should never be forgotten.

NASAL TIP: AESTHETICS (EXTRINSIC)

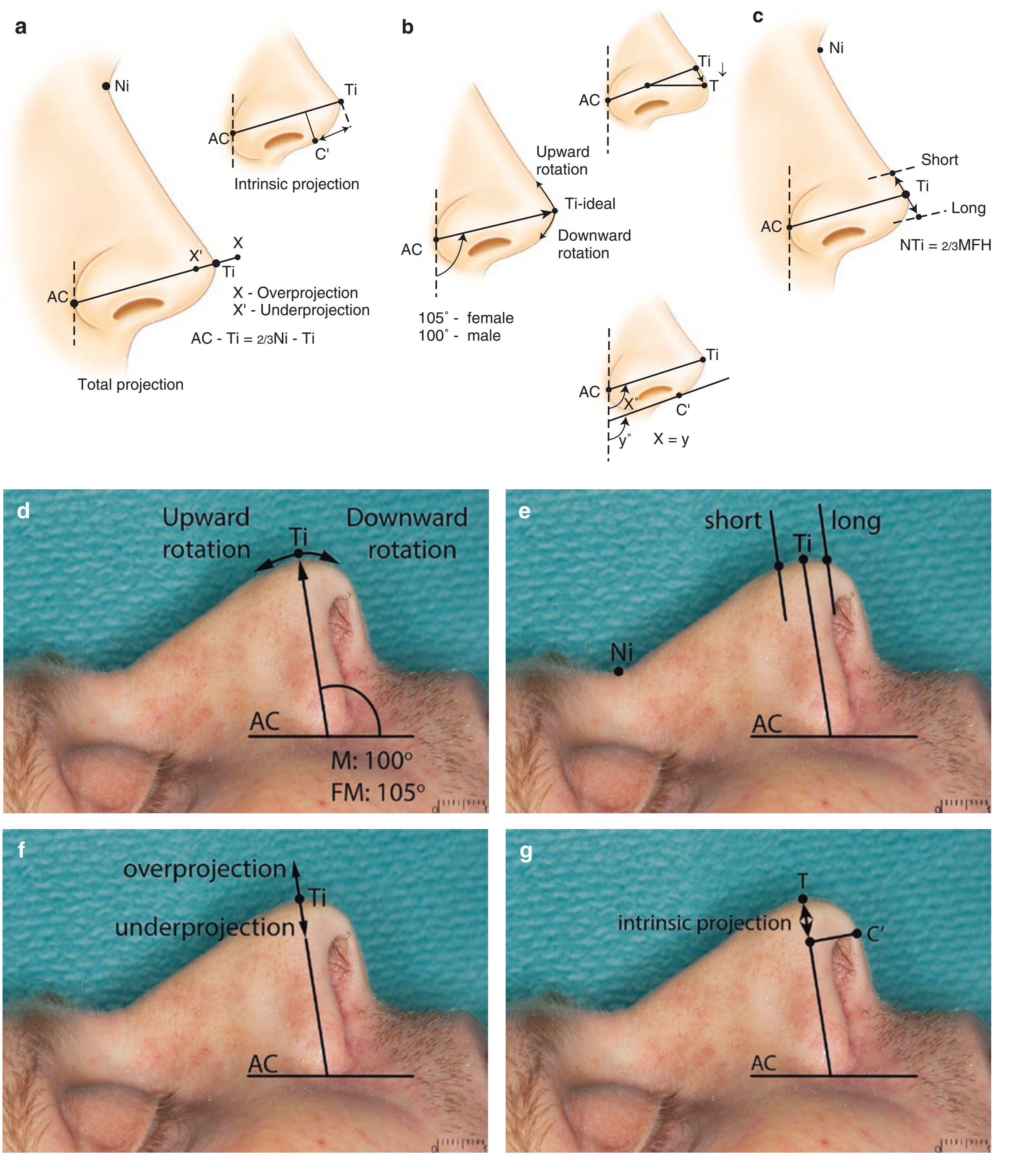


Fig. 2.4 Extrinsic tip aesthetics: (**a**) tip projection, (**b**) tip rotation, (**c**) tip position, (**d**) rotation (**e**) length, (**f**) total projection, (**g**) intrinsic projection. AC—alar crease; c′—columellar breakpoint; MFH—midfacial height

The ***extrinsic*** factors affecting the tip are often determined by the abutting supporting structures. Three main extrinsic characteristics can be described: projection, rotation, and position. ***Tip projection*** can be defined as the distance from a vertical facial plane passing through the alar crease (AC) to the nasal tip. One can measure *intrinsic projection* by a vertical from the columellar breakpoint to the tip projection line. ***Tip rotation*** is most easily defined as the *tip angle*, which is measured from the vertical plane at the alar crease to the tip. This angle is set at 103° for females and 98° for males. ***Tip position*** refers to the location of the tip along the dorsal line (N–T) and is of great concern in shortening the long nose. Essentially, one will often excise cephalic lateral crura (intrinsic) and caudal septum (extrinsic) to shorten the nose (Fig. 2.4).

MEDIAL CRUS: ANATOMY AND AESTHETICS

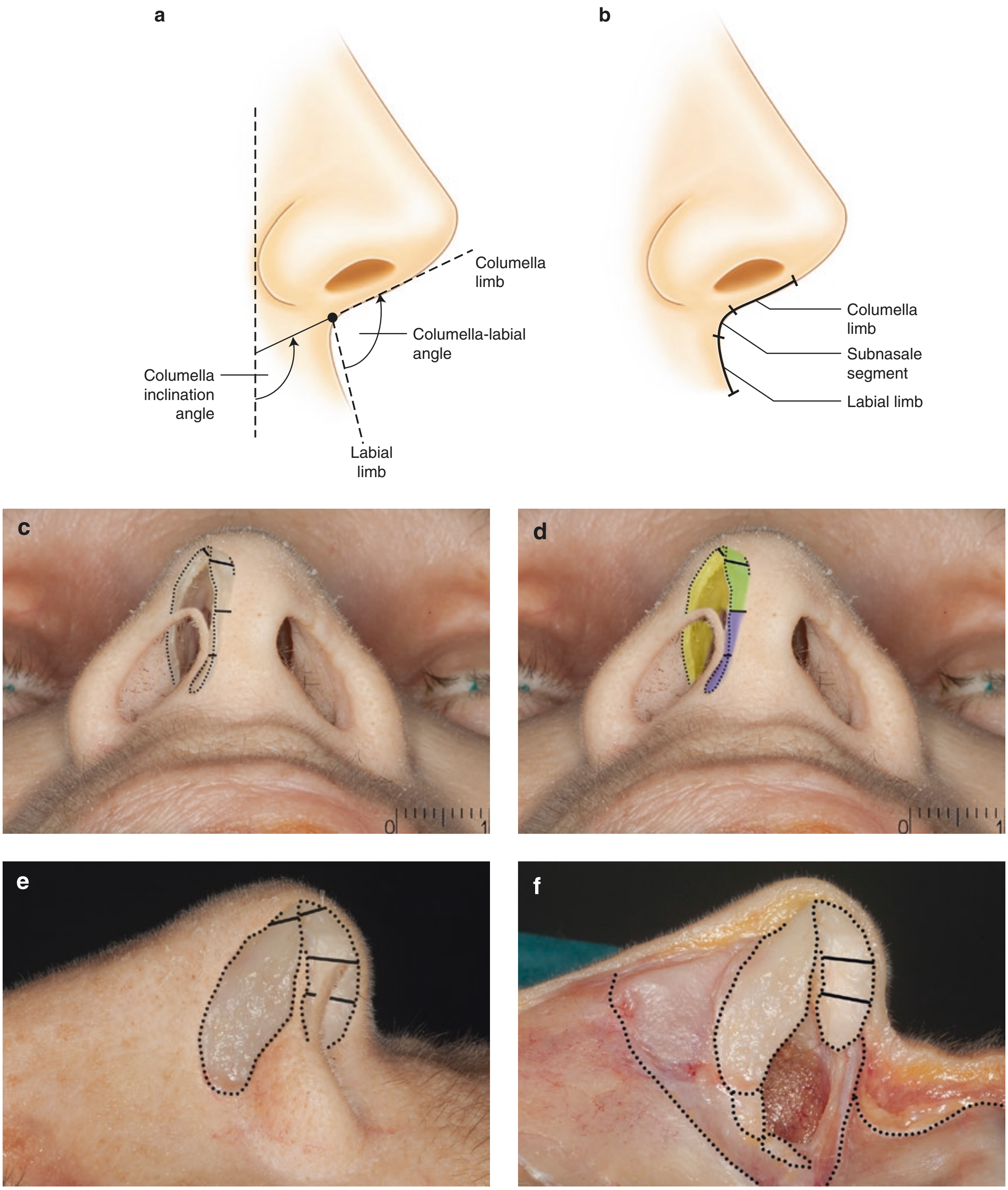


Fig. 2.5 (**a**, **b**) Columella inclination angle and columella-labial angle. (**c–f**) Position of the medial crus

In general, we assess four characteristics of the medial crus: (1) the columella-labial angle (CLA) on lateral view, (2) the columellar breakpoint (c′), (3) the top of nostrils in multiple views, and (4) the columellar base on basilar view. The CLA is created by the intersection of the columellar tangent and lip tangent at the subnasale (SN). Each component must be analyzed separately. The columellar limb is a very powerful indicator of upward nasal rotation. A true columella inclination angle (CA) is measured by extending the columellar tangent line back to the vertical axis passing through the alar crease. It should parallel the tip angle and be approximately 100° in females and 90–95° in males. The columella should have a slight convexity, avoiding a retruded concavity or a hanging prominence. The *labial limb* relates to the upper lip, with the ideal at −6° from the upper lip vertical (Fig. 2.5).

MEDIAL CRUS: ANATOMY AND AESTHETICS

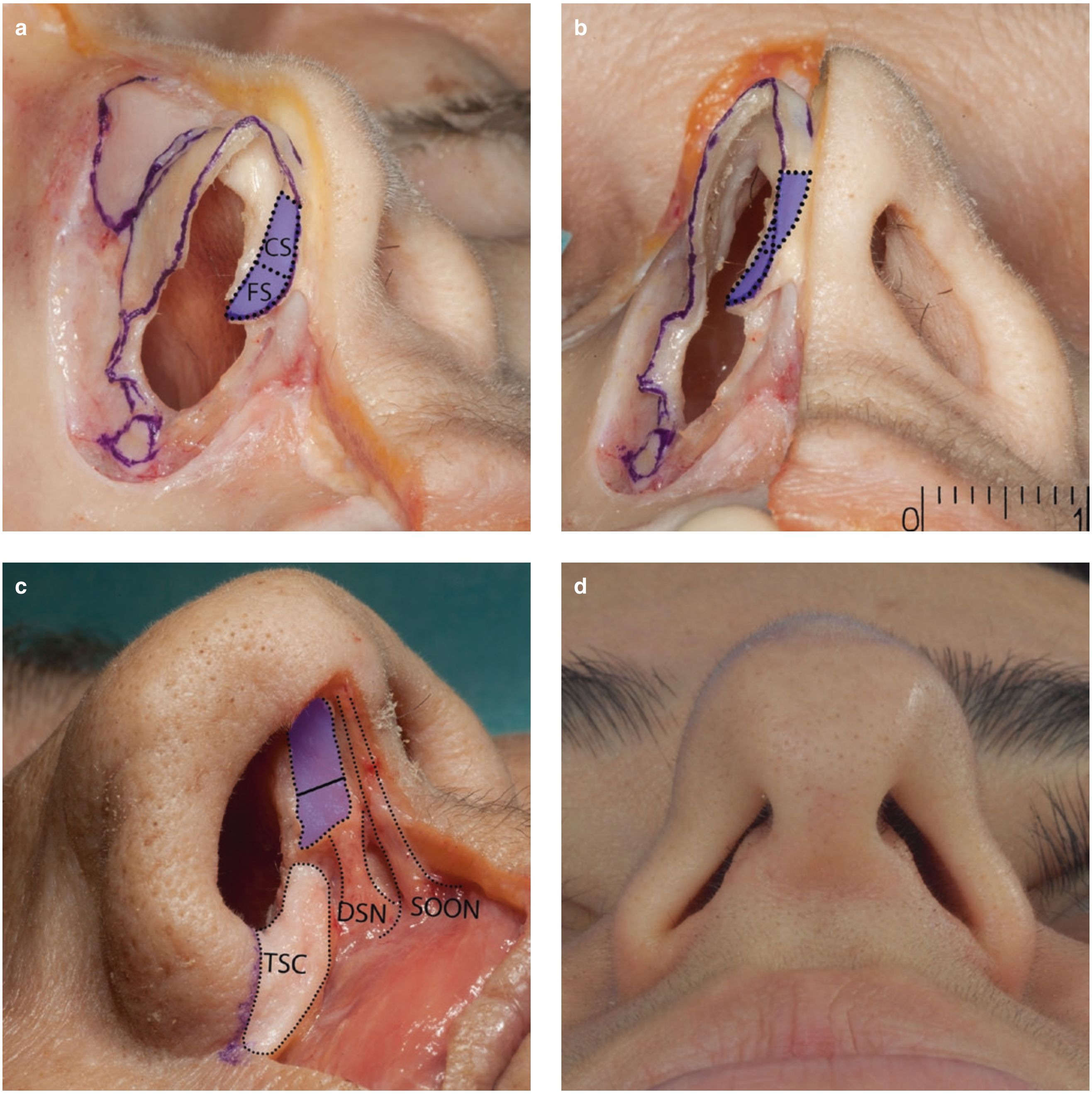


Fig. 2.6 (**a**, **b**) The footplate segment (FS) and columellar segment (CS) of the medial crus. (**c**) The depressor septi nasalis (DSN) and superficial orbicularis oris nasalis (SOON) of the columellar base. (**d**) Nasal wall collapse due in part to a wide columellar. TSC—tela subcutanae cutis

The footplates of the medial crura course laterally and slightly cephalically in a dual angulation (Guyuron 1998). The footplates are held together by a transverse footplate fibrous sling. The divergence point of the paired medial crura abuts the caudal septum. Overly divergent footplates provide weak tip support. In addition, they can encroach into the nostril sills and reduce nostril size. In most cases, the more divergent the footplates, the more dependent the tip. Dynamic change can be observed during alteration of the footplates. After approximating the footplates, the tip projection increases, as does tip stability. The columellar base becomes narrower and the subnasale soft tissue advances caudally (Fig. 2.6).

MEDIAL CRUS: ANATOMY AND AESTHETICS

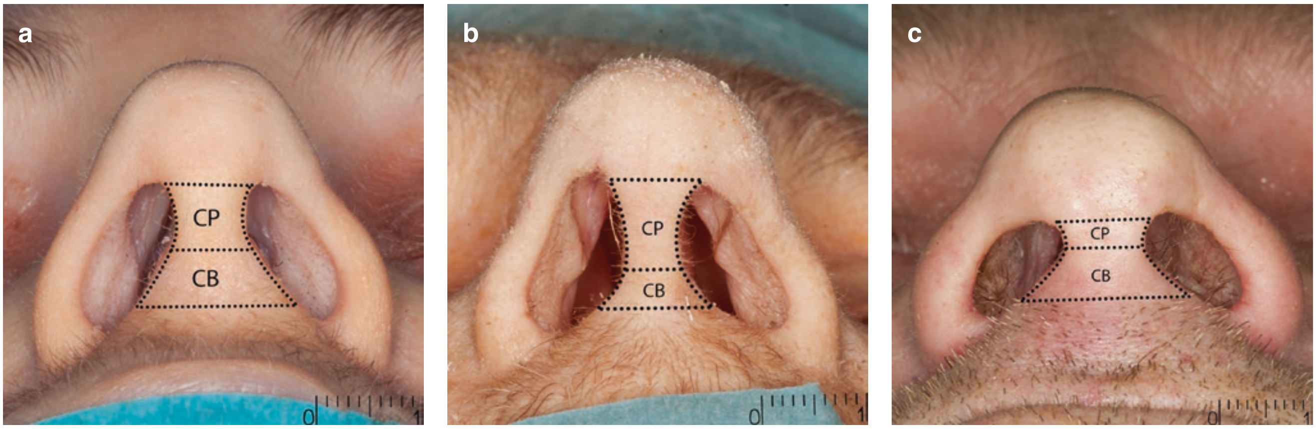


Fig. 2.7 (**a–c**) Normal and reciprocally disproportionate columellar pillar (CP) and base (CB), as defined by the medial crura

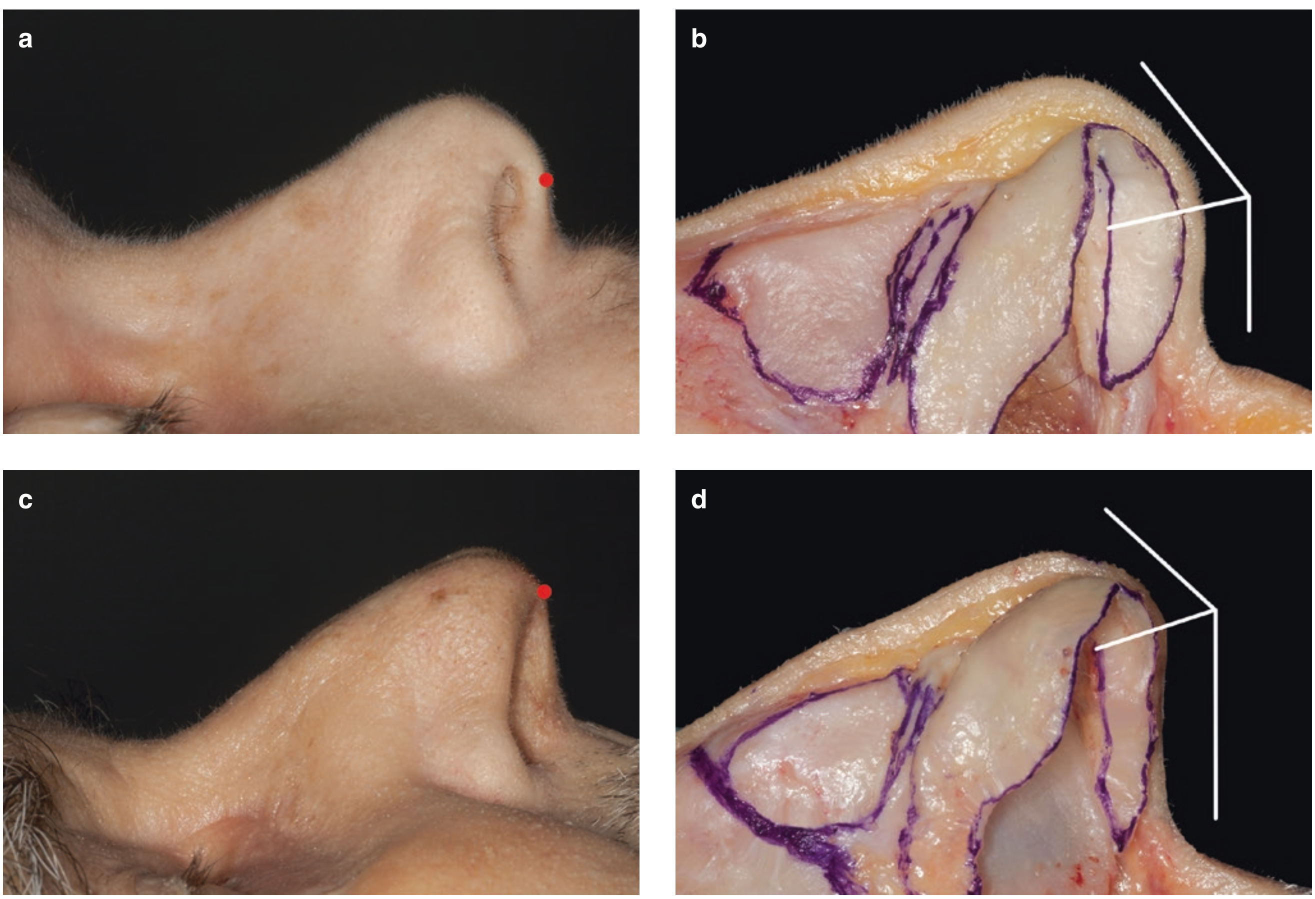


Fig. 2.8 (**a**, **b**) Low variation of the columellar breakpoint (c′). (**c**, **d**) High variation. Both variations affect the columella and infralobule length

On basilar view, the columellar base gradually widens as it transitions from the narrow waist of the columellar into the variable flare of the footplates before transitioning into the nostril sills (Fig. 2.7). One must avoid the extremes of excessive width, which can compromise the nostril aperture, and excessive narrowness, which creates an artificial surgical look. As shown in Fig. 2.8, the position of c′ can vary dramatically relative to the top of the nostril, from −3 mm to +2 mm. This variation in turn emphasizes the reciprocal length relationship between the medial and middle crus.

MEDIAL CRUS: ANATOMY AND AESTHETICS

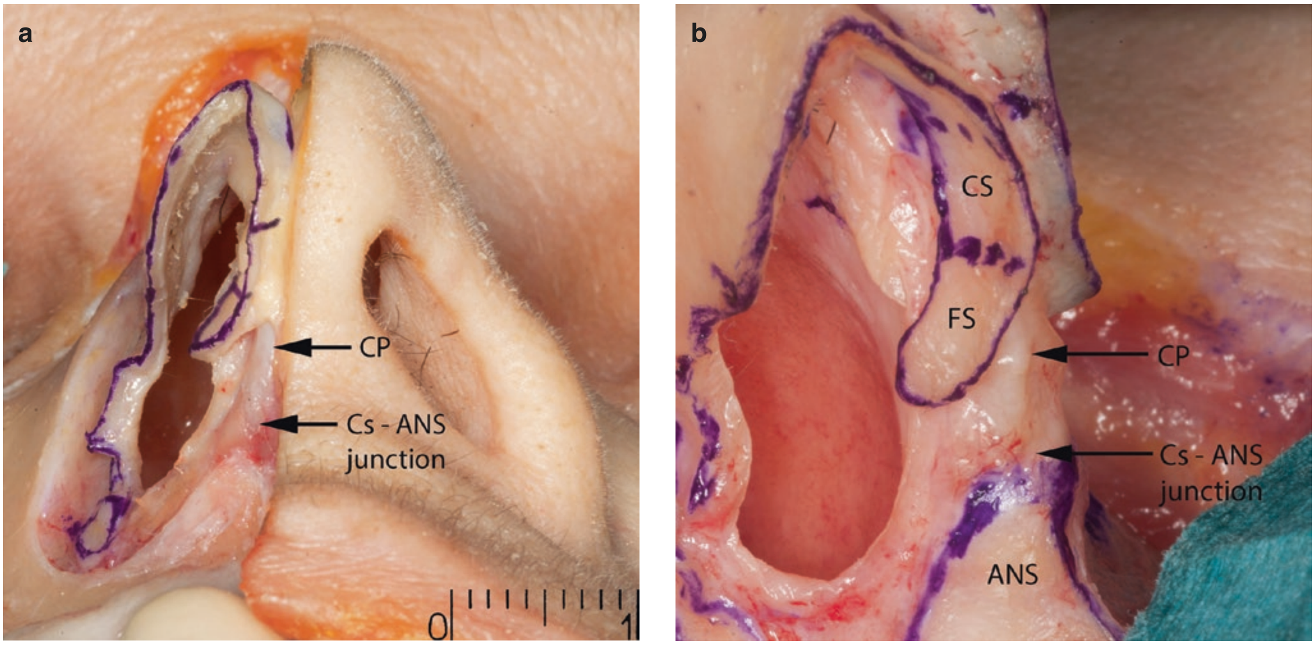


Fig. 2.9 (**a**, **b**) Normal columellar base, medial crus. Normal divergence of the footplates exposes the caudal septum (Cs) from the its most caudal point (CP) to the anterior nasal spine (ANS). FS—footplate segment, CS—columellar segment

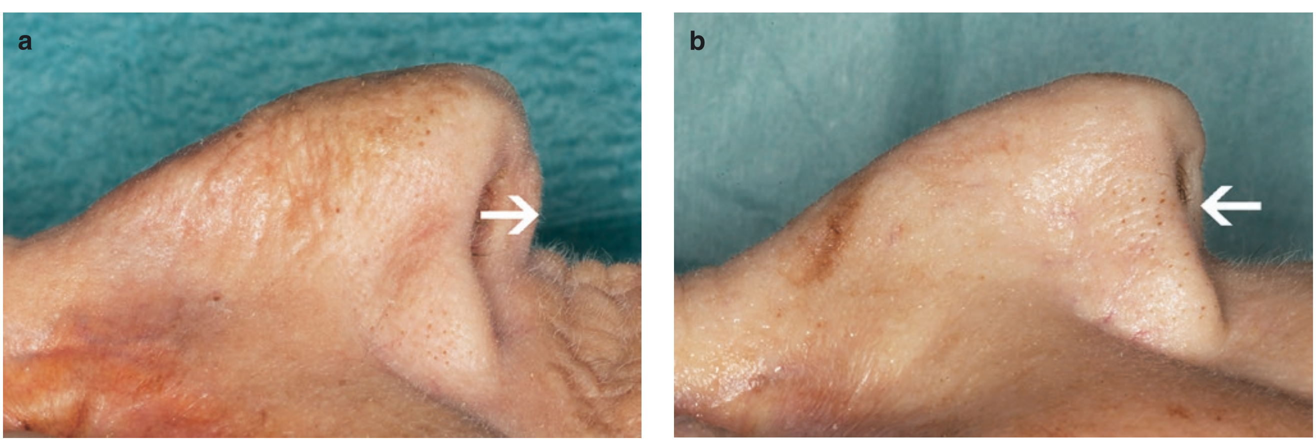


Fig. 2.10 Columellar deformities include (**a**) hanging and (**b**) retracted

As shown in Fig. 2.9, there is a powerful relationship between the medial crus and the caudal septum. Once the footplates diverge from the lobular segment of the medial crus, the caudal septum is exposed for a distance of 6–10 mm down to its junction with the anterior nasal spine (ANS). Anatomically, the columellar base is devoid of alar cartilage, and its width is determined by soft tissue (Daniel et al. 2013). With increased utilization of columellar struts, this finding explains the visibility one can encounter if the strut is made too long. Also, it demonstrates the difficulty of narrowing the columellar base in patients with short footplates, as there is no cartilage to suture. Rather, one must excise the intervening tissue and then control the skin envelope (Fig. 2.10).

MEDIAL CRUS: FOOTPLATE AND COLUMELLAR SEGMENTS

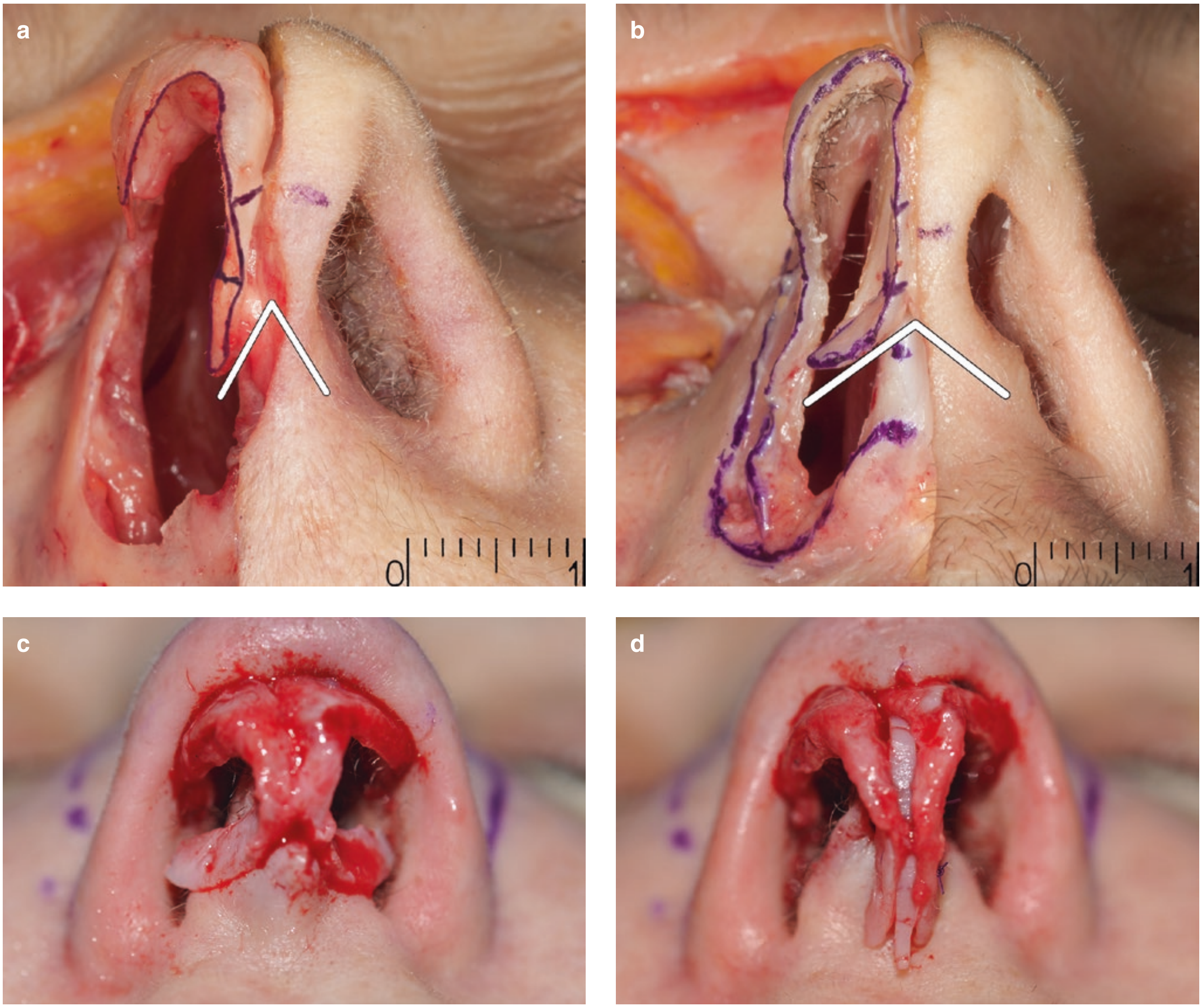


Fig. 2.11 Footplate segments can be (**a**) minimally divergent or (**b**) widely divergent. Divergent medial crura are (**c**) mobilized up to c′ and then (**d**) sutured to a columellar strut

The ***footplate segment*** begins at the point of divergence medially and ends at their round terminus laterally. Guyuron (1998) recorded their dimensions as follows: length 5.8 mm, width 4.5 mm, and distance apart 11.4 mm. He advocated three possible modifications: (1) mobilization followed by suture approximation when the columella is retruded and the tip is under-projected; (2) suture approximation to narrow the wide columellar base, with optional excision of intervening soft tissue; and (3) excision of the footplates to reduce tip over-projection, a technique that is rarely indicated and has limited effectiveness. Recently, Ghavami et al. (2008) have begun to routinely mobilize the footplates in making major modifications to the tip architecture. If one excludes tongue-in-groove procedures, we surgically manipulate the footplates in fewer than 5% of cases (Fig. 2.11).

MEDIAL CRUS: FOOTPLATE AND COLUMELLAR SEGMENTS

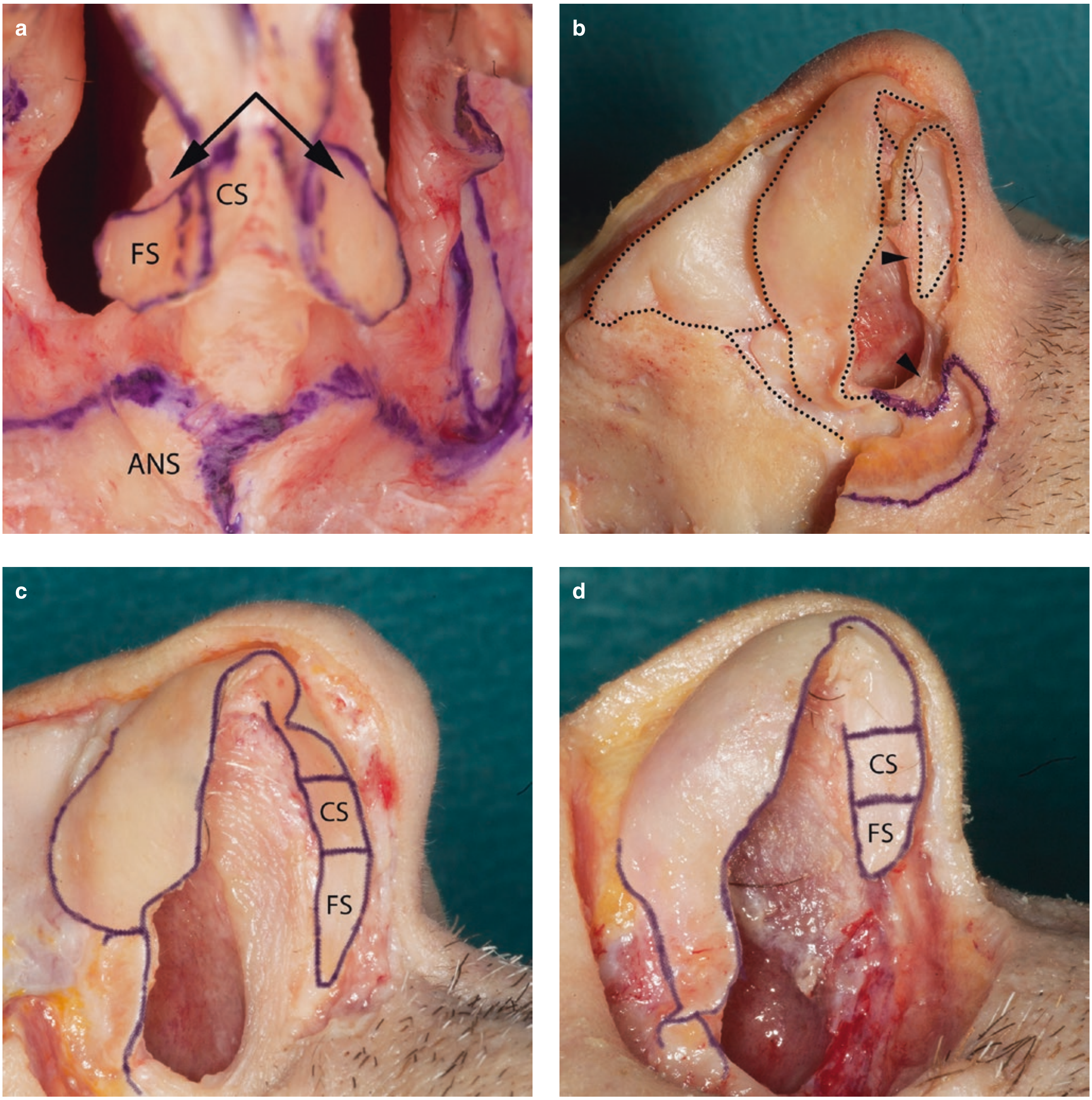


Fig. 2.12 (**a**) Divergence of the columellar segment (CS). (**b**) Retrocolumellar fold (*upper arrowhead*). (**c**, **d**) Long and short footplate segments (FS)

The ***columellar segment*** represents the upper half of the medial crus and correlates with the narrow waist of the columellar. It begins at the point of divergence of the two crura inferiorly and ends at the columellar breakpoint (c′). The two most common clinical deformities are asymmetry and long or short length. The columellar segment is usually straight, but can be quite reciprocal, a condition that is usually correctable with suture approximation to a crural strut. The question of length forces consideration of the relationship between the columellar segment and the infralobular segment of the middle crus. For example, when the columellar breakpoint is 2 mm below the nostril apex, is the pathology a short columellar segment of the medial crus or a long infralobular segment of the middle crus? In almost all cases, we concentrate on correcting the middle crus. The major exception is in many ethnic noses (Asians, Hispanics, Blacks), where major lengthening of the columellar segment is done (Fig. 2.12).

MEDIAL CRUS: RETRACTED COLUMELLA (CASE STUDY)

Analysis: A 43-year-old man presented with the complaint that he did not like his droopy nose. On exam, there was minimal tip support (Figs. 2.13 and 2.14). The columella-labial angle (CLA) was 80°, the nostril angle was 72°, and the tip angle was 88°. There was no history of previous trauma or nasal surgery.

Operative Technique:

1. An open approach followed by a tip split for access to the septum.
2. Septal harvest, no dorsal reduction, no osteotomies.
3. Major tip support with a 30-mm × 10-mm septocolumellar strut.
4. Insertion of a columella plumping graft.

Commentary: At 2 years postop, the CLA has been improved, with a dramatic change in columellar inclination. Equally, the CLA has gone from acute to a more normal obtuse. On basilar view, a true columella and a columellar base have appeared, and the nostrils have been converted from round to angular.

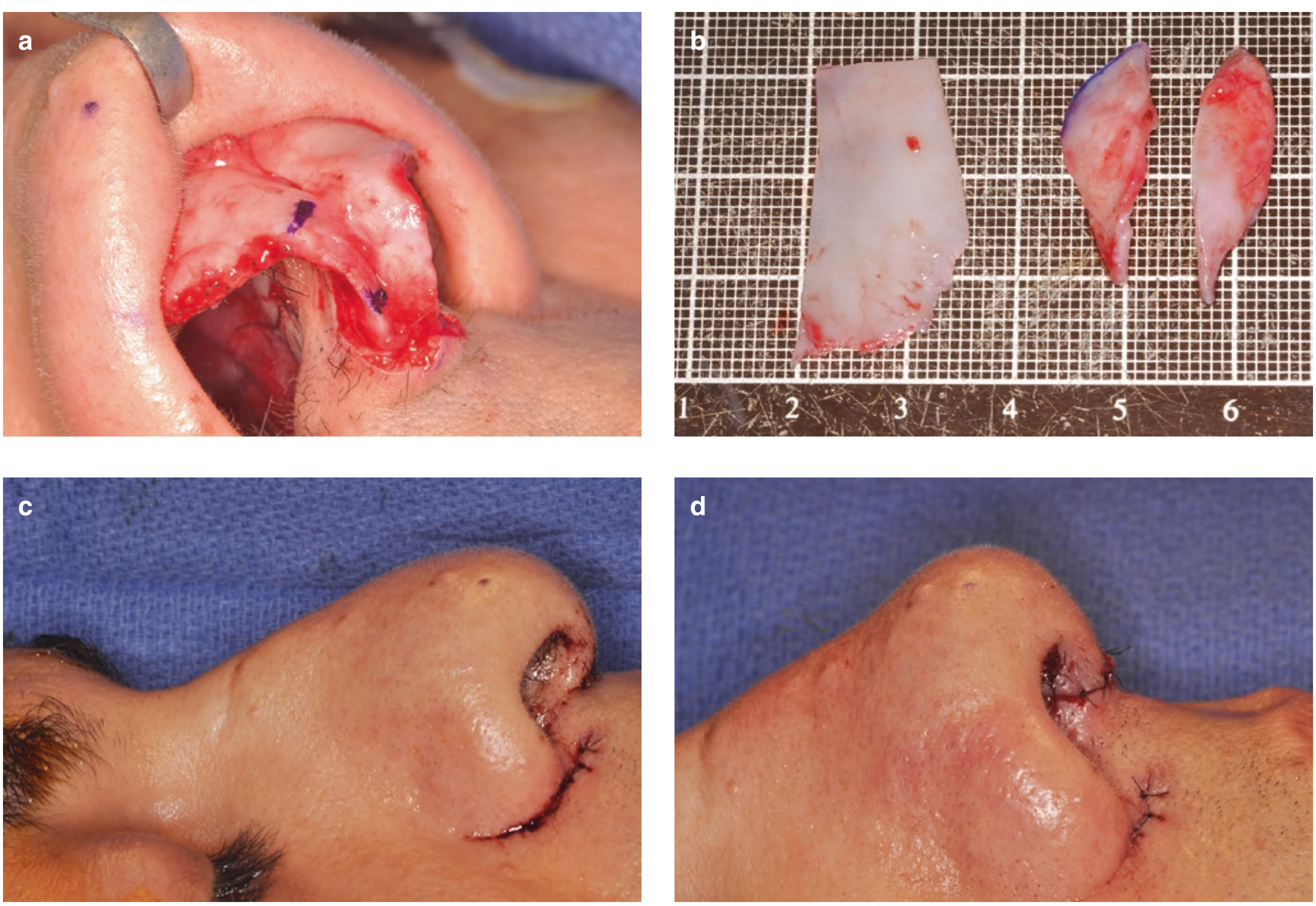


Fig. 2.13 (**a–d**) Intraoperative photographs

MEDIAL CRUS: RETRACTED COLUMELLA (CASE STUDY)

Fig. 2.14 (**a–h**) Case study patient with retracted columella before treatment (*left*) and 2 years after treatment (*right*)

MEDIAL CRUS: TONGUE-IN-GROOVE OPERATION (CLASSIC)

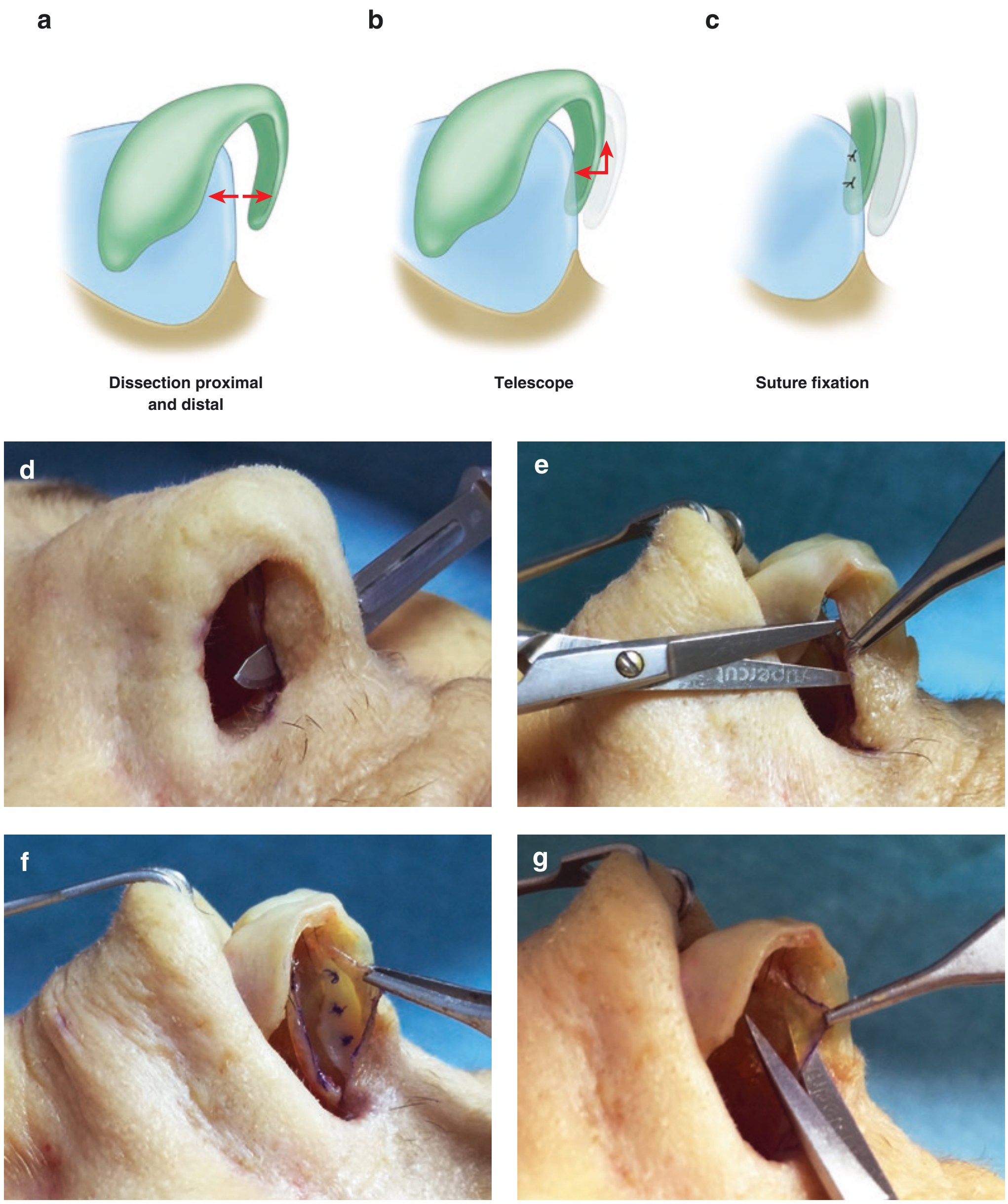


Fig. 2.15 (**a–g**) Classic tongue-in-groove technique

The tongue-in-groove (TIG) operation (Fig. 2.15) was popularized by Kridel et al. (1999) for treating the hanging columella, using the following specific steps:

1. Correction of any caudal septal deviation via bilateral full transfixion incisions
2. Retrograde dissection between medial crura, with optional soft tissue excision
3. Telescoping of the columella onto the caudal septum
4. Fixation with 4-0 chromic sutures
5. Bilateral membranous septum excision

Toriumi (1999) emphasized that one must be careful about projection, rotation, and the alar/columella relationship. In our experience with secondary rhinoplasty patients having a prior TIG procedure, we have found the common errors to include under-resection of the anterior nasal spine (ANS), persistent deviation of the caudal septum, and excessive upward tip rotation. As with any procedure, there is a learning curve.

MEDIAL CRUS: TONGUE-IN-GROOVE OPERATION (MODIFIED)

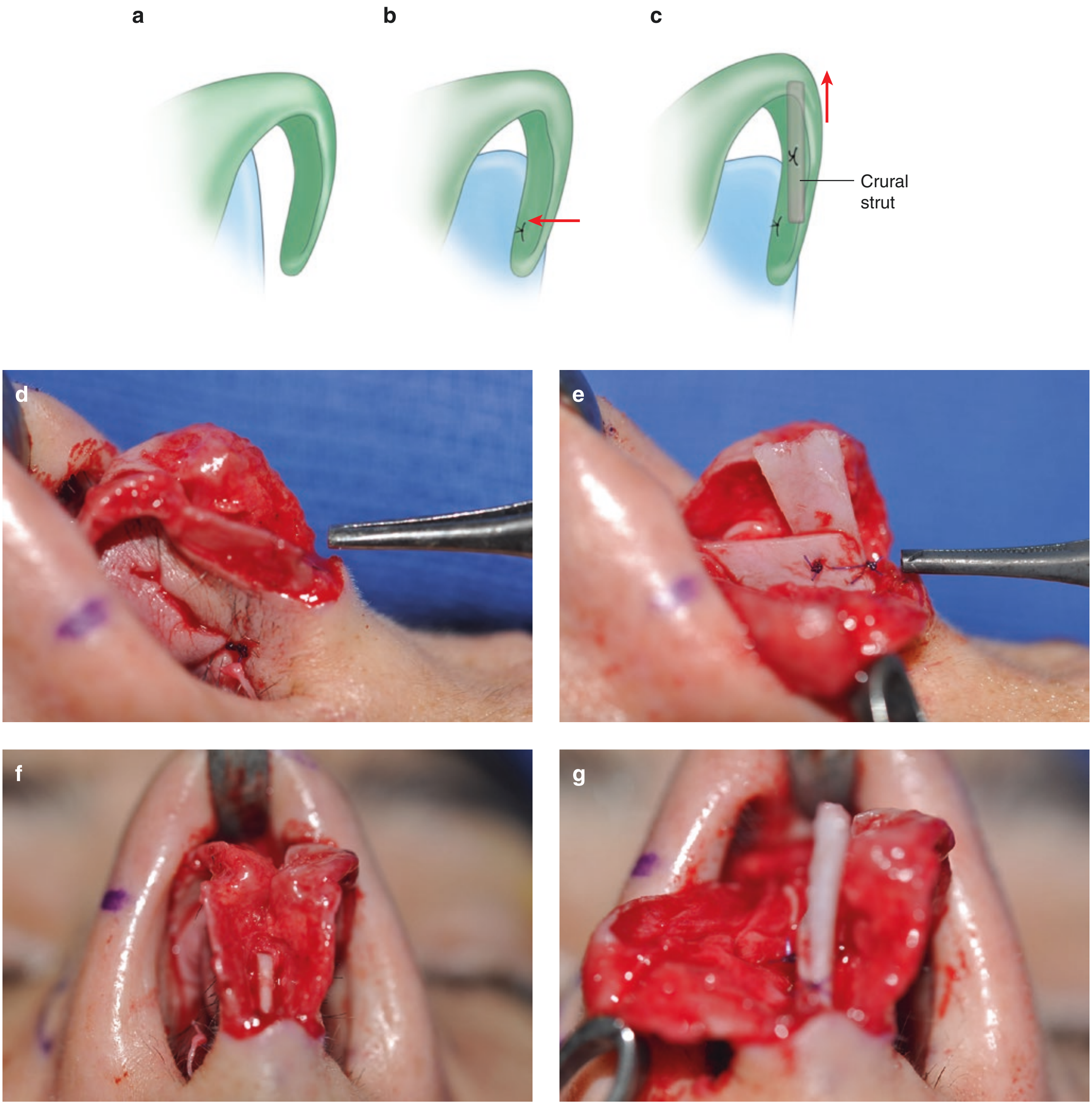


Fig. 2.16 (**a–g**) Modified tongue-in-groove technique

The inherent problems associated with the TIG procedure can be minimized if it is confined to correcting the *columellar inclination*. As seen in Fig. 2.16, the medial crura have been telescoped onto the caudal septum and fixed with a 4-0 PDS sutures. The forceps is pointing at the anterior septal angle (ASA), the highest point on the dorsal profile. To achieve tip projection, it is necessary to add a columellar strut (Fig. 2.16e, g). The alar cartilages will be sutured to the strut, thus achieving the necessary 8–10 mm of projection. In addition, the strut will be mobile, resulting in a flexible tip. There is no attempt made to project the tip onto the caudal septum, nor to rotate the tip against the caudal septum. This modified TIG allows one to control the columellar inclination without the associated problems of a classic TIG.

MEDIAL CRUS: CLASSIC TONGUE-IN-GROOVE (CASE STUDY)

Analysis: A 24-year-old man disliked his nose, especially the profile and droopy tip. Photographic analysis revealed a columellar inclination of 83°, which became 78° on smiling; the tip angle was 92°. Thus, correction of the columellar inclination (83° static, 78° smiling) was critical.

Operative Technique:

1. An open approach with a transfixion incision for septal harvest.
2. Dorsal reduction (B 0.5, C 3.5) followed by osteotomies (medial oblique [MO] and low-to-low [LL]).
3. Resection (2.5 mm) and relocation of caudal septum.
4. Tongue-in-grove fixation of medial crura to caudal septum (Fig. 2.17a).
5. Narrowing of the columellar base by rotation of the soft tissue cephalically and 4-0 PDS suture (Fig. 2.17b, c)
6. Control of tip position and projection with a columellar strut (Fig. 2.17d).

Commentary: The critical decision was to achieve correction of columellar inclination using a tongue-in-groove technique. The medial footplates were "telescoped" onto the caudal septum and sutured. Then a columellar strut was added to project the tip above the dorsal line. Note postoperative tip mobility (Fig. 2.18).

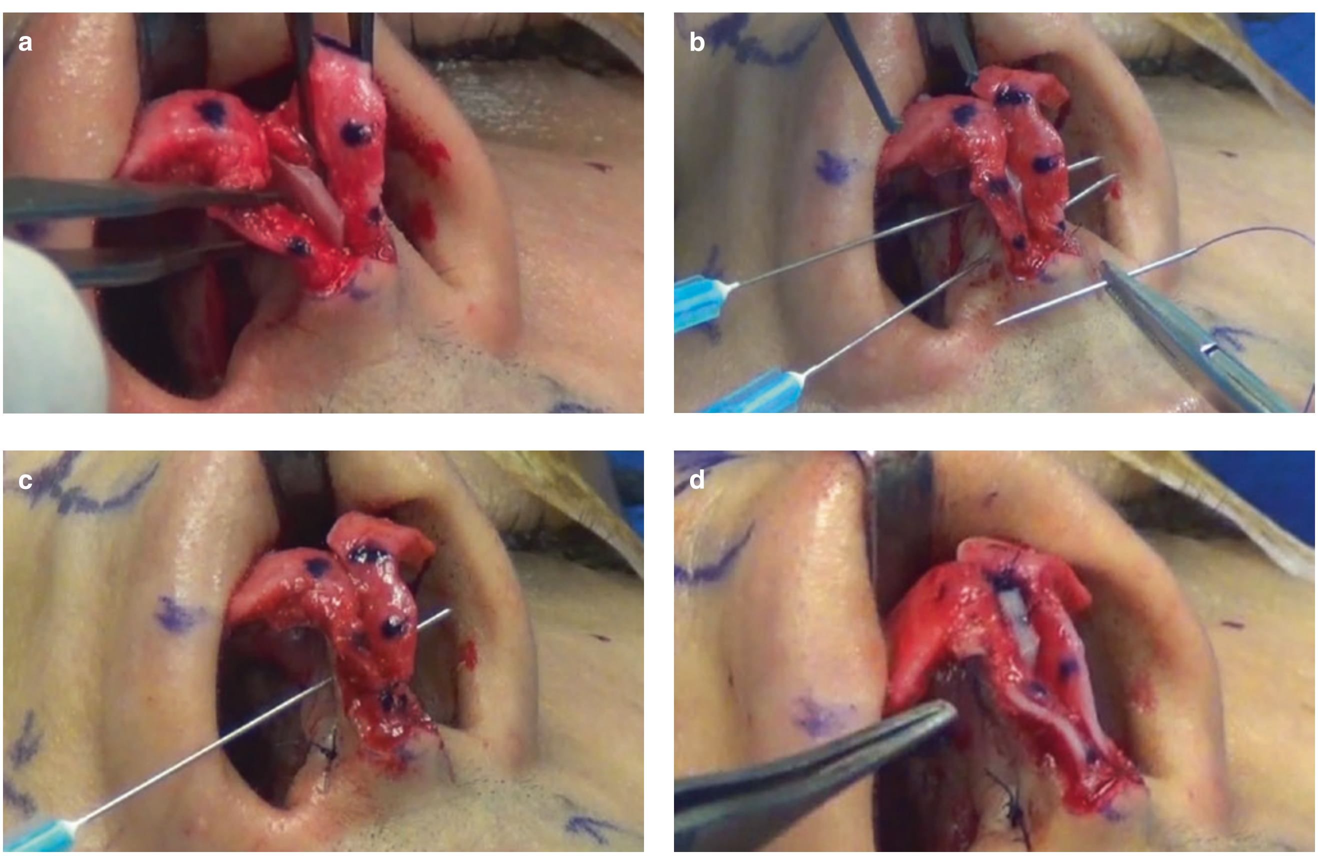


Fig. 2.17 (**a**–**d**) Modified tongue-in-groove operation

MEDIAL CRUS: CLASSIC TONGUE-IN-GROOVE (CASE STUDY)

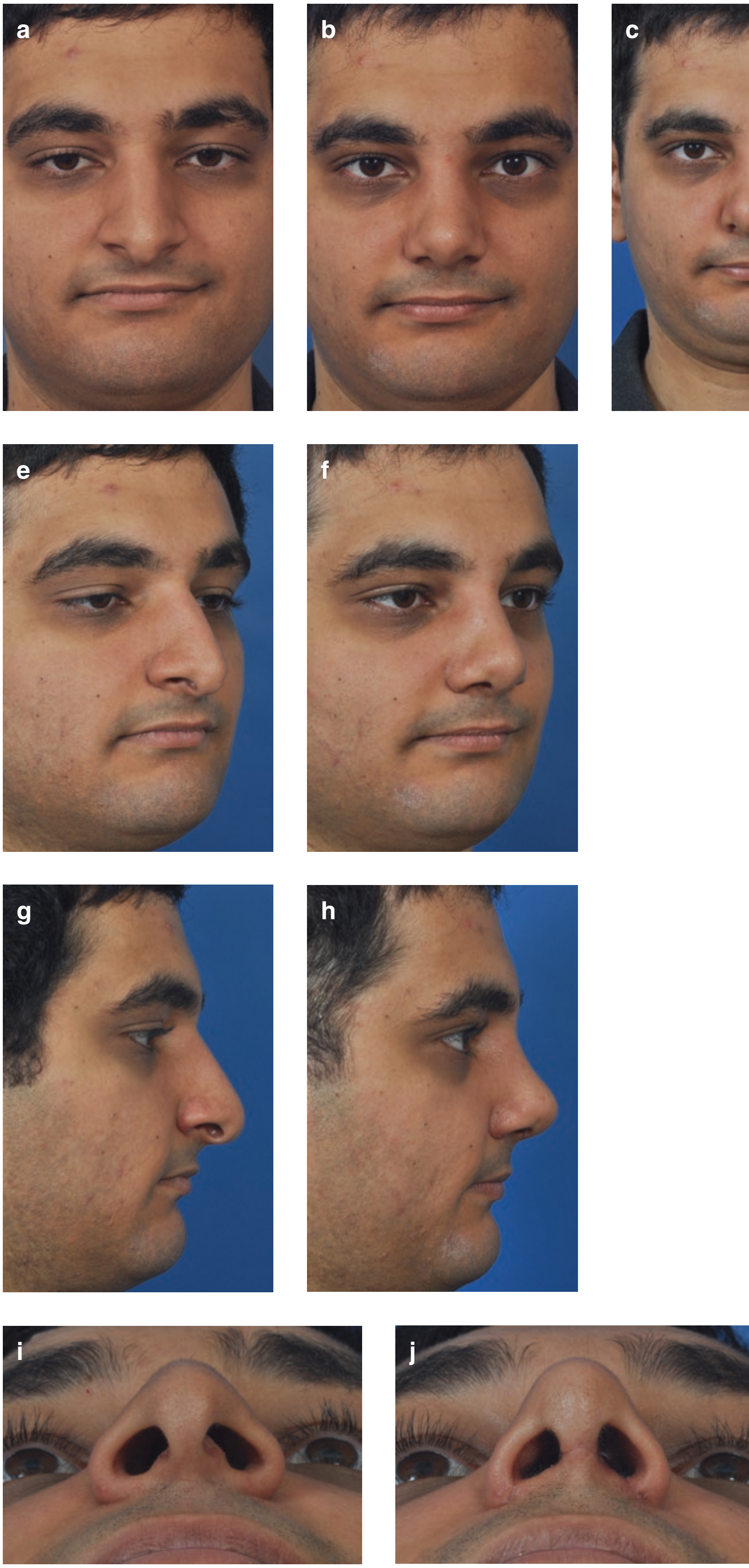


Fig. 2.18 (**a–j**) Case study patient before treatment (*left*) and after correction of columellar inclination (*right*)

MEDIAL CRUS: COLUMELLAR SEGMENT (CASE STUDY)

Analysis: A 25-year-old woman presented with a simple complaint: "I hate my witchy nose." She did not like her dependent, wide tip and large nostrils. On photographic analysis, the smiling view confirmed that the ANS was not prominent and that the deformity was intrinsic to her medial and middle crura.

Operative Technique:

1. Open approach revealed "splayed" alar cartilages (Fig. 2.19a).
2. Incremental dorsal reduction (B 1.0, C 4.0). Caudal septal resection 4.5 mm.
3. Columellar strut insertion with tip sutures: CS, DC, ID, DE, TP, LCCs.
4. Addition of a shield-shape time refinement graft (TRG). Alar rim grafts inserted bilaterally.

Commentary: As seen on lateral view (Fig. 2.20), the patient's dominant deformity was the downward inclination of her columella from the columellar base to the nostril apices. Once the nose was opened, it was obvious that the etiology was intrinsic to the lobular segment of the medial crus—a problem corrected by careful positioning and suturing to the columellar strut. As will be discussed later, suturing of the alars onto the columellar strut provides stability and allows the surgeon to reorient the alar cartilages, leading to an increase in the intrinsic projection of the tip; note the greater length from c′ to T.

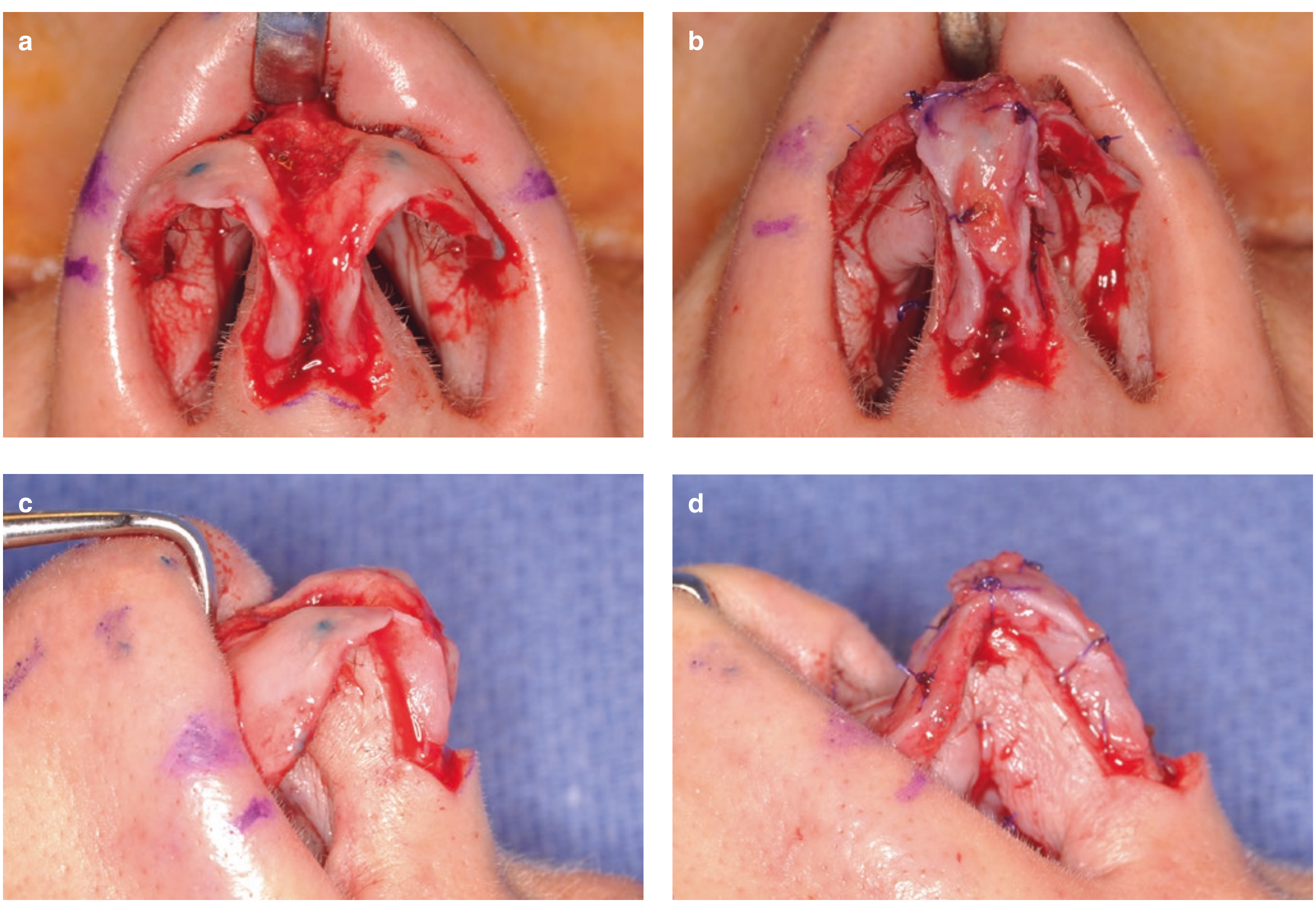


Fig. 2.19 (**a–d**) Operative technique for correction of deformity intrinsic to medial and middle crura

MEDIAL CRUS: COLUMELLAR SEGMENT (CASE STUDY)

Fig. 2.20 (**a–j**) Patient before and 1 year after correction of downward inclination

MIDDLE CRUS: LOBULAR SEGMENT

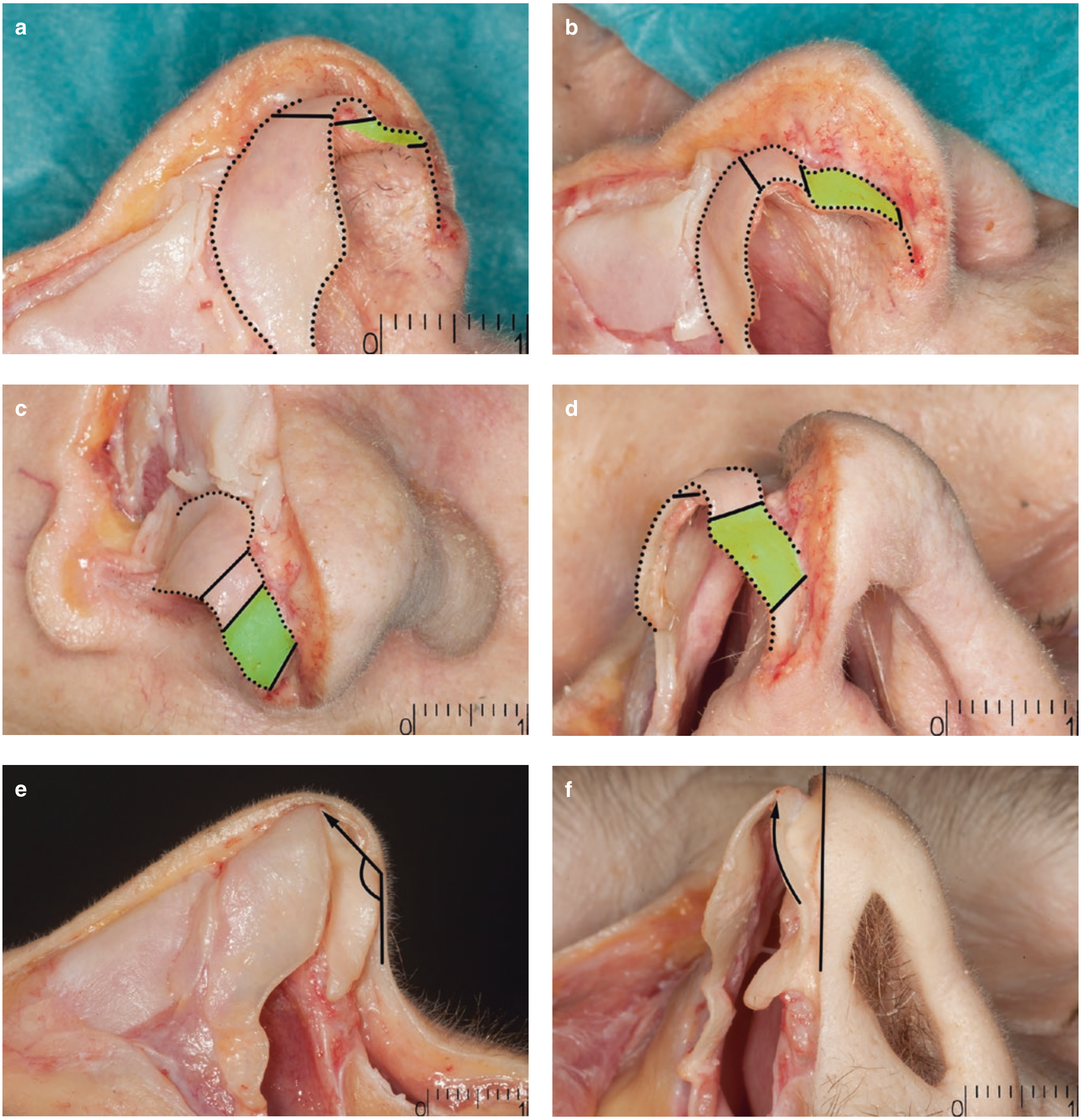


Fig. 2.21 (**a–d**) Lobular segment of the middle crus. (**e**, **f**) Columella-lobular angle and the divergence of the lobular segments

The **middle crus** can be subdivided into an *infralobular segment* and a *domal segment*. The ***lobular segment*** of the middle crus begins at the columellar breakpoint (c′) and ends at the medial genu of the domal notch (Fig. 2.21). The anatomic characteristics are discussed in the next section. Clinically, the major deformity of the lobular segment is its pervasive asymmetry in all parameters. Simply put, the lobular segments are never symmetrical, and they require great attention to detail to control their ultimate aesthetic impact. Surgeons have concentrated a great deal of effort on achieving tip definition by suturing the domal notch, but final tip symmetry is often determined by suturing the lobular segment.

MIDDLE CRUS: LOBULAR SEGMENT

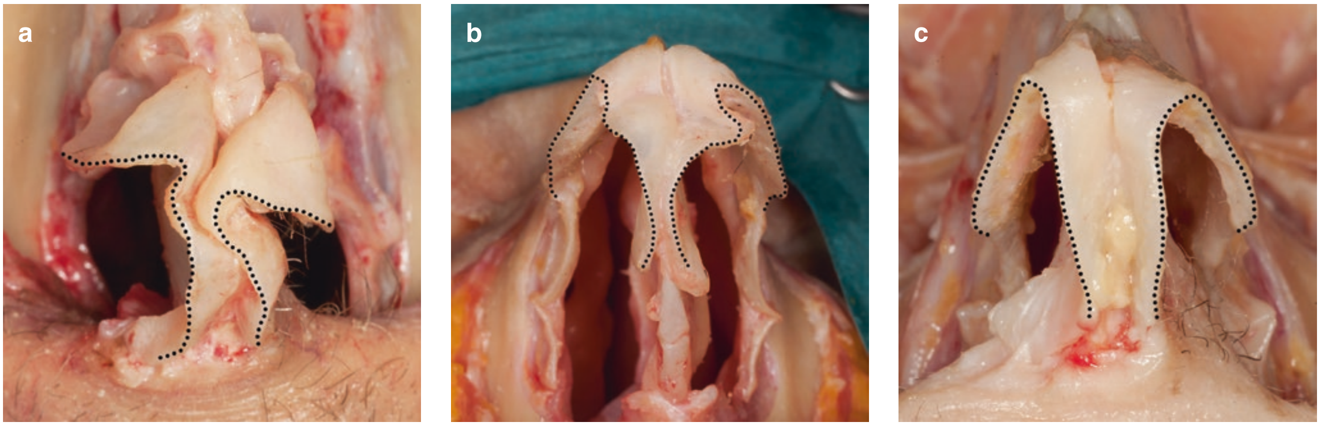


Fig. 2.22 Variations in shape of lobular segment includes (**a**) reciprocal, (**b**) widely divergent, and (**c**) straight

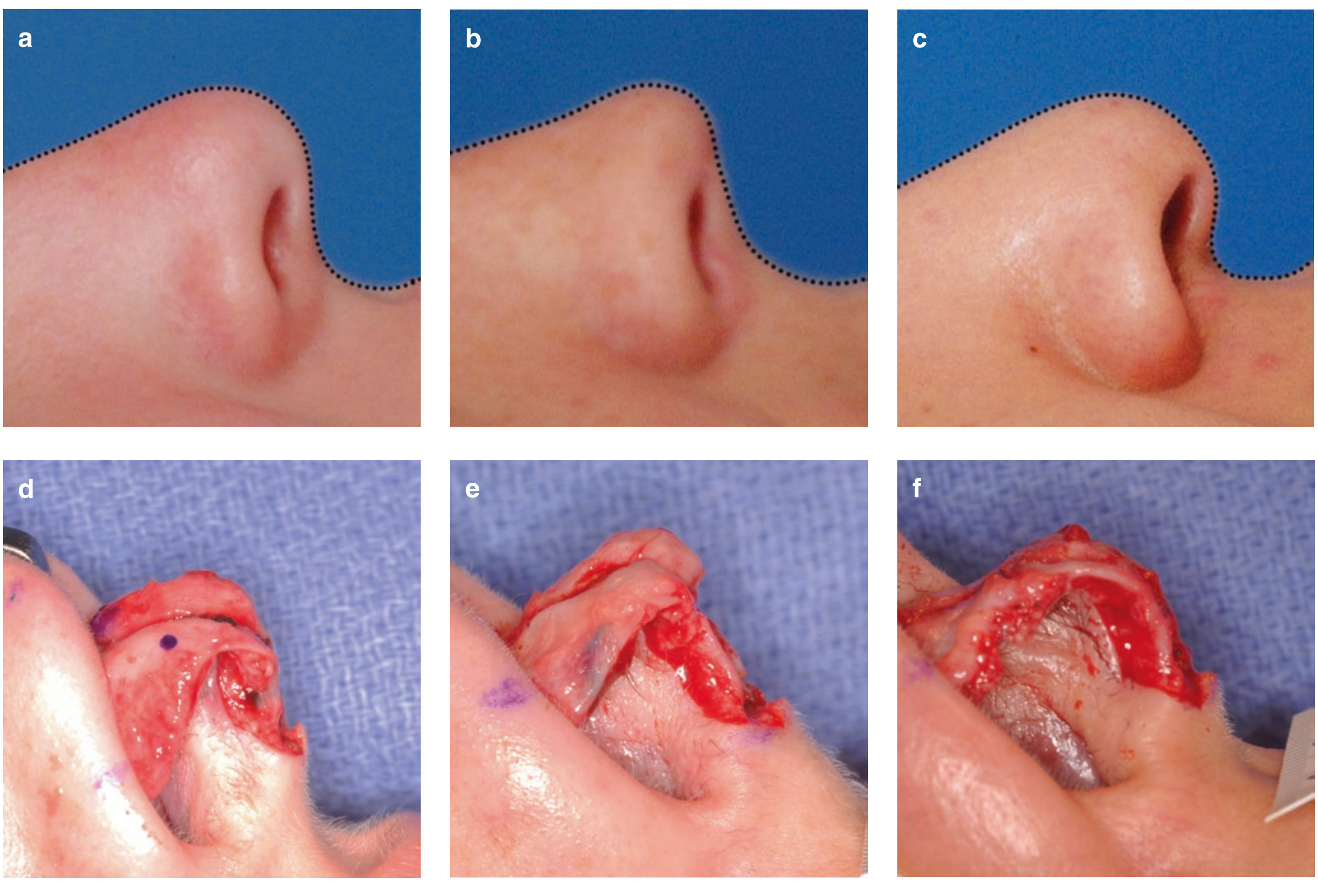


Fig. 2.23 Shape of the lobular segment includes (**a**, **d**) normal, (**b**, **e**) concave, and (**c**, **f**) convex

The shape of the l**obular segment** varies in width and length, which can have a profound effect on tip shape (Fig. 2.22). On lateral view, the shape of the lobular segment is classified as straight-angled (27), convex (12), and concave (1). As shown in Fig. 2.23, these shapes correlate directly from the skin surface to the underlying anatomy. One can draw a straight line from c′ to T and then a perpendicular line upward to the most convex point on the infralobule (I). When one elevates the skin, it is obvious that c′ correlates with the divergent point of the middle crus from the medial crus, that I is the medial genu of the domal notch, and that it is at the lateral genu of the domal notch. The linkage between surface aesthetics and alar anatomy correlates directly.

MIDDLE CRUS: DOMAL SEGMENT

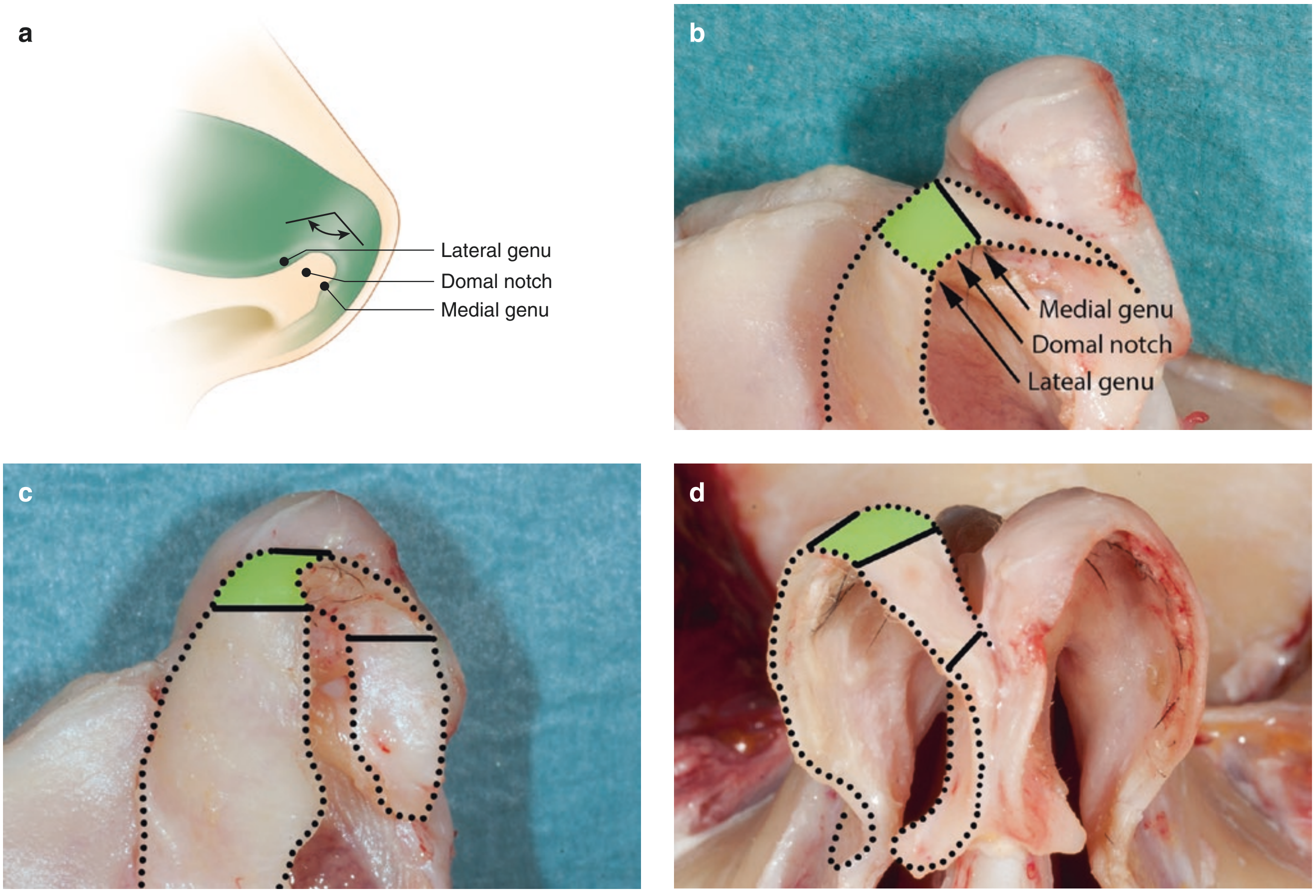


Fig. 2.24 (**a–d**) Domal segment of the middle crus

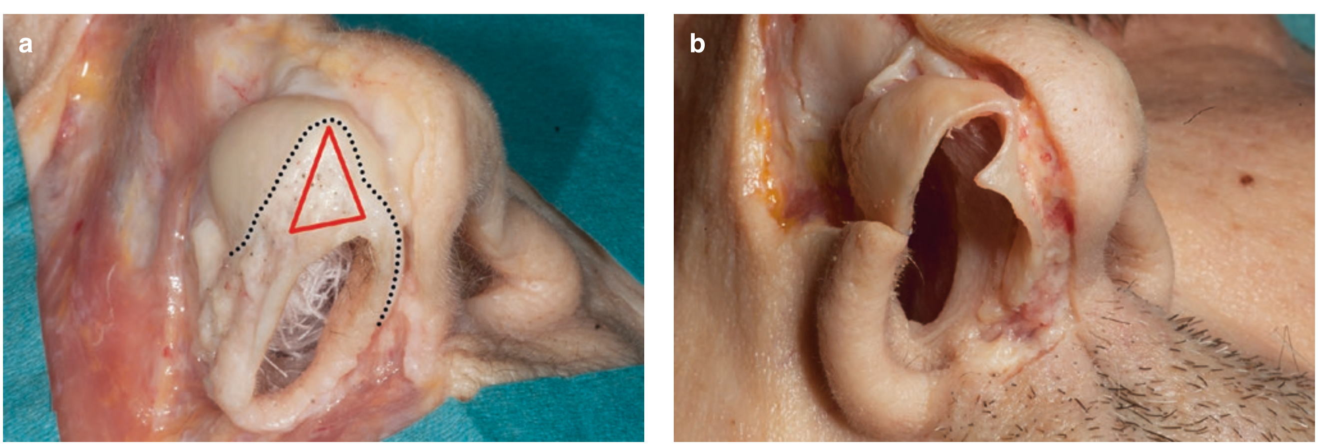


Fig. 2.25 (**a**) Soft triangle. (**b**) Overdeveloped medial genu reduces the soft triangle

Definition is a true aesthetic concept, which implies the degree of detail, refinement, and angularity of the tip. It is determined anatomically by the adjacent relationship between the *convexity* of the domal segment and the *concavity* of the lateral crus, with its surface expression revealed or obscured by the overlying skin. The anatomical configuration that correlates with the best tip definition is a convex domal segment with adjacent concave lateral crura. The critical importance of the skin envelope should never be forgotten. The *tip width* refers to the interdomal distance, the width of the tip diamond. The ideal interdomal width correlates often with the width of the philtral columns and the dorsal lines (Figs. 2.24 and 2.25).

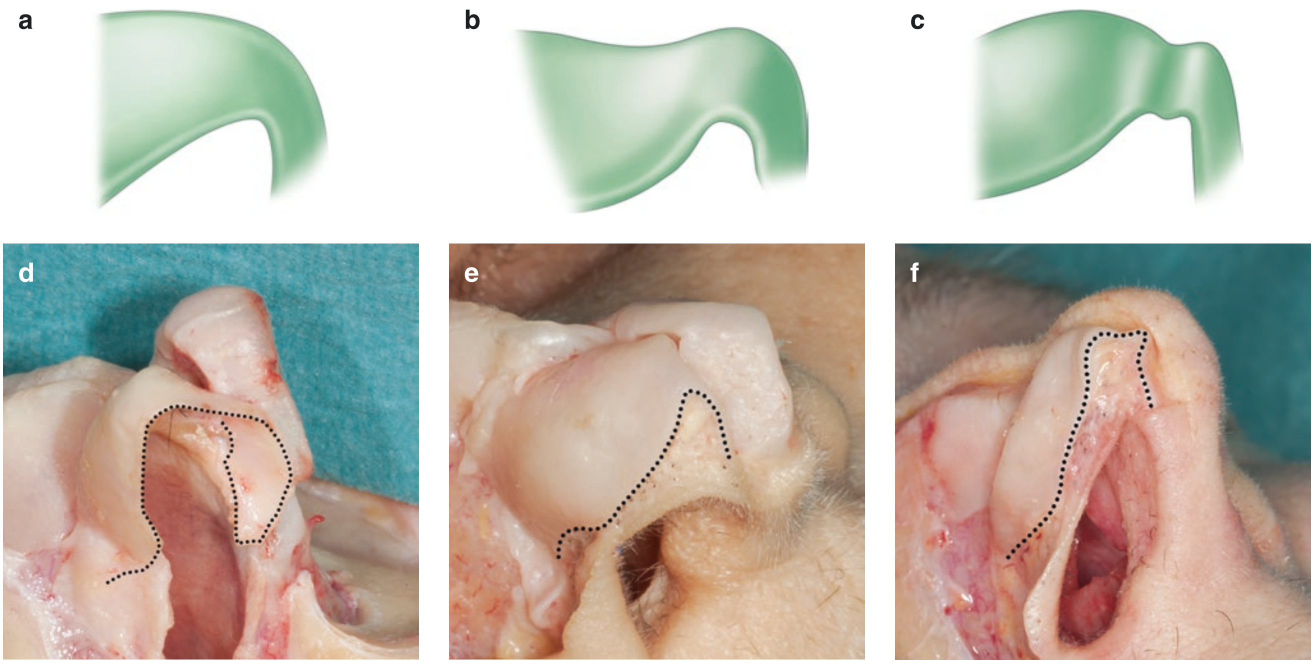


Fig. 2.26 Smooth, convex, concave domal segment shapes: (**a**–**c**) schematic, (**d**–**f**) cadaver

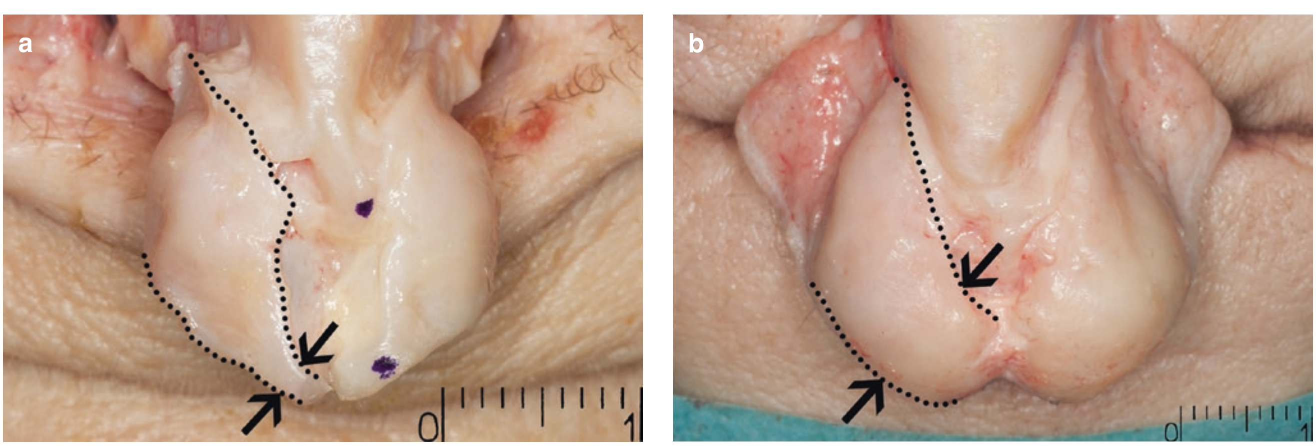


Fig. 2.27 (**a**) Extremely narrow domal segment (1.5 mm). (**b**) Extremely wide domal segment (9.5 mm)

The domal segment extends from the medial genu, which marks its transition with the infralobular segment, to the lateral genu, which marks its junction with the lateral crus. It brackets the domal notch, which in turn influences the soft triangles or soft tissue facets of the lobule. The shape of the domal segment varies from smooth to convex to concave (Fig. 2.26). Anatomically, the most aesthetic configuration is a convex domal segment adjacent to a concave lateral crus. It is this configuration that one is trying to produce with domal sutures. The average width of the domal segment is 6 mm, but the dome may be narrow or broad (Fig. 2.27). When the domes are narrow, tip grafting may be necessary. Wide domes are easily reduced by extending the cephalic excision medially onto the middle crus, as required in 3–4% of cases.

MIDDLE CRUS: TIP SUTURES—SYMMETRICAL RIM EXCISION

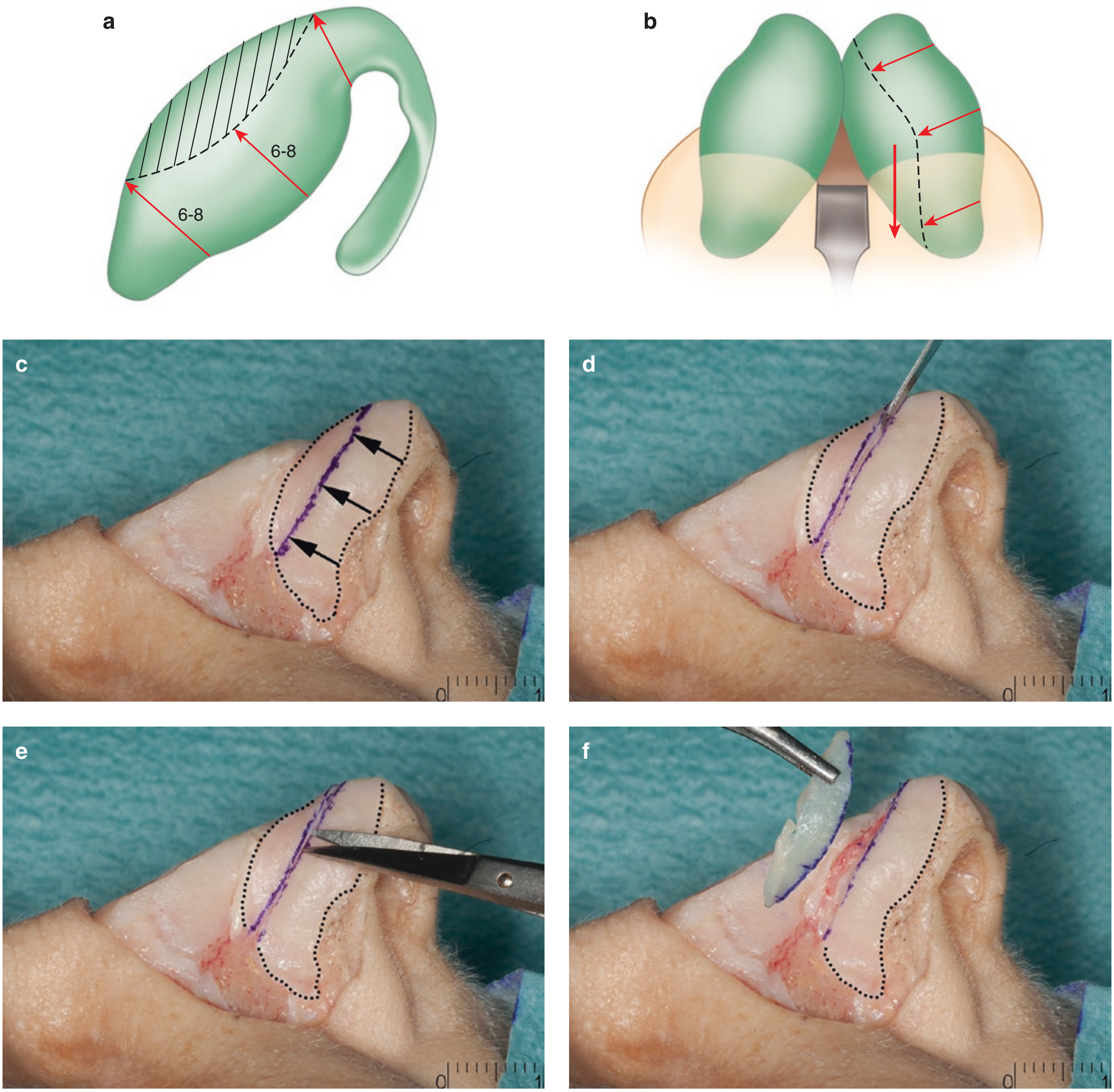


Fig. 2.28 (**a**–**f**) Symmetrical rim excision

The tip suture operation described here was first done in 1984 by the senior author and refined over the intervening years (Daniel 1992, 1999). Once the open approach is completed, the alar cartilages are analyzed as to configuration, size, and symmetry. If a major concavity of the lateral crus is present, one must consider the option of turn-over or turn-under flaps. Also, one must decide if the incision will be followed by *preservation* or *excision* of the cephalic cartilage above the line of incision. Drawing the incision line involves three steps: (1) a 6-8mm width at the widest point; (2) tapering toward the dome to preserve its width (narrowing the domal notch area is rarely necessary); (3) following the caudal border of the lateral crura, preserving a 6-8mm width (Fig. 2.28). Owing to the marked narrowing of the lateral crus, the lateral incision line is usually vertical to the caudal border. A 6-8mm rim strip allows insertion of any requisite shaping sutures, as well as retaining sufficient support for the nostril rim and minimizing alar retraction.

MIDDLE CRUS: TIP SUTURES—COLUMELLAR STRUT

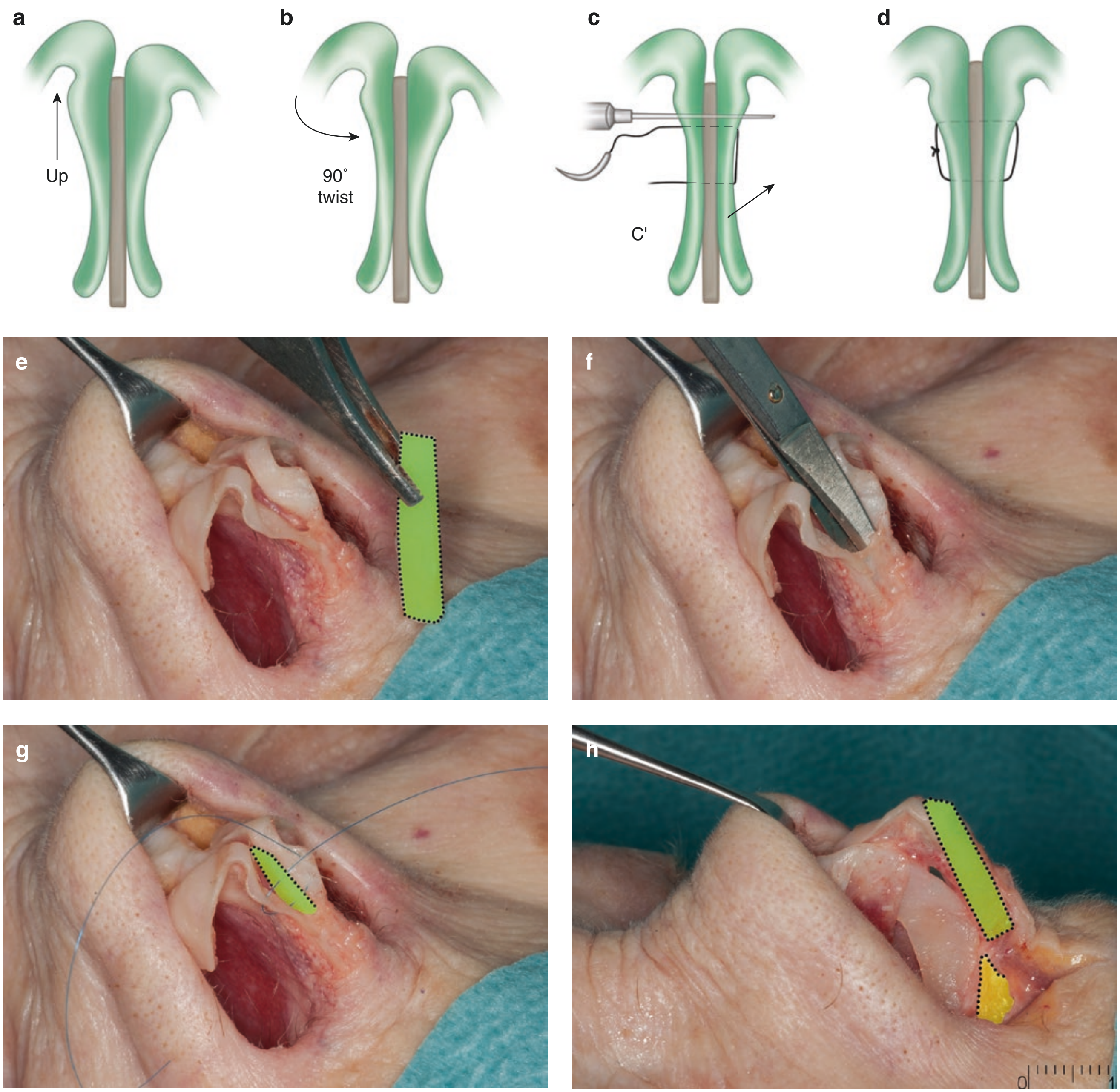


Fig. 2.29 (**a–h**) Insertion and suturing of the columellar strut

The columellar strut and **columellar suture (CS)** provides tip stability and influences columellar shape. Suturing the alars to the strut creates a unified tip complex and improves symmetry. Equally important, the strut provides a rigid intrinsic shape for the columella, thus rendering it somewhat independent of caudal septal deviations. The three steps are shaping, insertion, and suture fixation. Although the shape can vary, the columellar strut is usually cut 20 mm long, 2.5 mm wide, and 1.5 mm thick. The pocket between the alar cartilages is easily made by vertical spreading of the dissection scissors downward toward the ANS. The alars are elevated upward, rotated toward the midline, and fixed individually to the strut with a #25 needle (Fig. 2.29). Symmetry is important as regards domal location and caudal relationships. The columellar suture consists of a vertical suture of 5-0 PDS. The needle enters at the columellar breakpoint, passes through the alars and strut, and then crosses again high in the infralobule, so that the suture is totally within the middle crura. Note that the columellar strut does **not** rest on the ANS; it is free-floating and cannot "click" across the ANS.

MIDDLE CRUS: TIP SUTURES—DOMAL CREATION

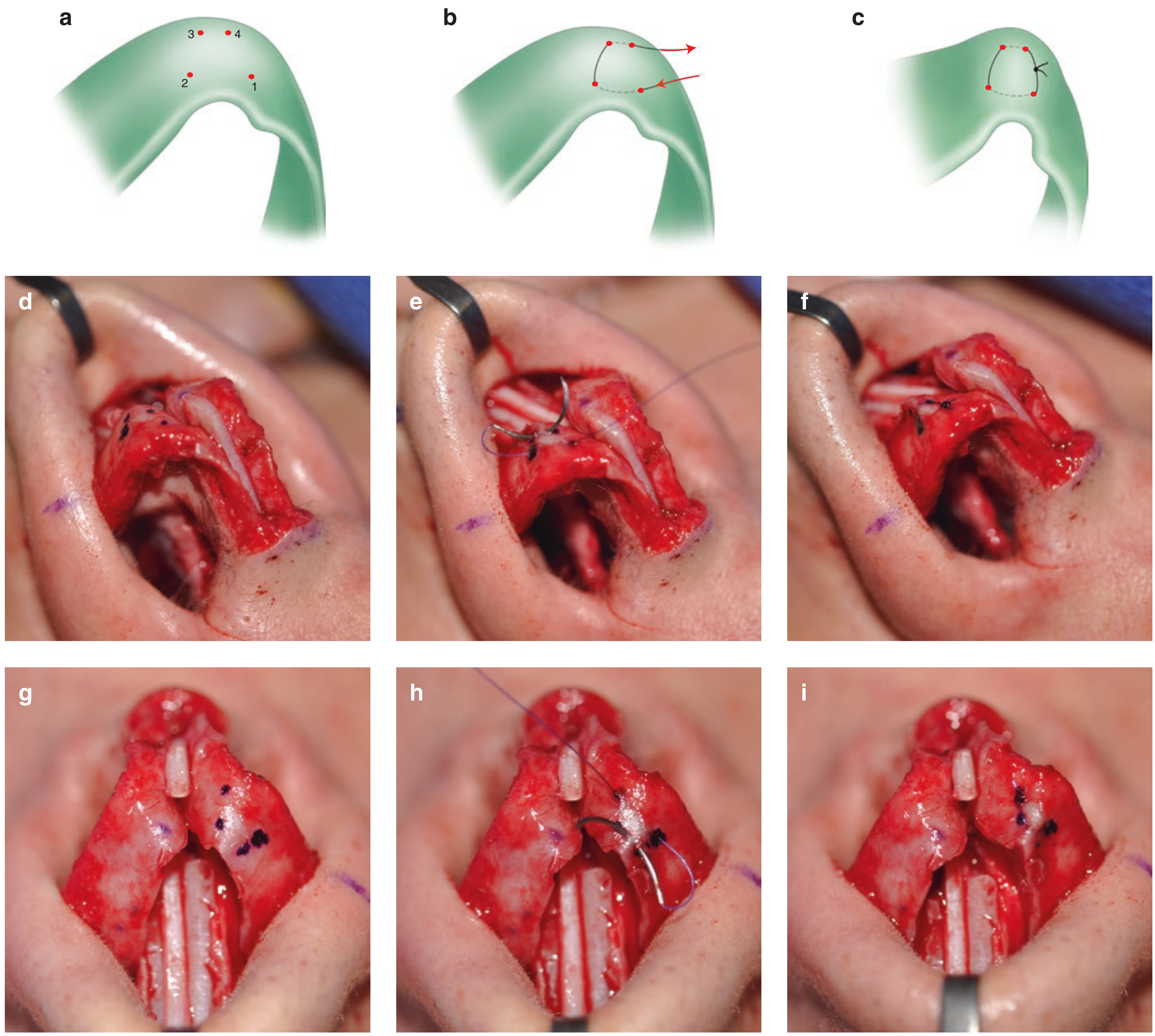


Fig. 2.30 (**a–i**) Domal creation suture (DC)

The **domal creation suture (DC)** produces tip definition by creating the ideal aesthetic tip anatomy even from flat or concave cartilages (Daniel 1991). The goal is the *juxtaposition* of gradually increasing domal *convexity* next to gradually increasing lateral crura *concavity*. A short-cord needle (P3) with highly visible, violet-colored absorbable suture material is used—never permanent sutures. The domal notch is located, and the domal segment is gently squeezed using forceps to determine the exact location for the suture and the amount of convexity. The desired dome-defining point is marked. Originally, a horizontal mattress suture was placed from medial to lateral, with the knot tied medially. The tension was gradually tightened until the desired domal convexity was achieved. Early experience indicated that the suture should be placed more cephalically than caudally, and the shape should be more of a polygon than a parallelogram. Specifically, the caudal bite should be wider and the cephalic bite, narrower. Both modifications result in the desired definition, with less impact on the soft tissue facet and position of the caudal border of the adjacent lateral crus (Fig. 2.30).

MIDDLE CRUS: TIP SUTURES—INTERDOMAL

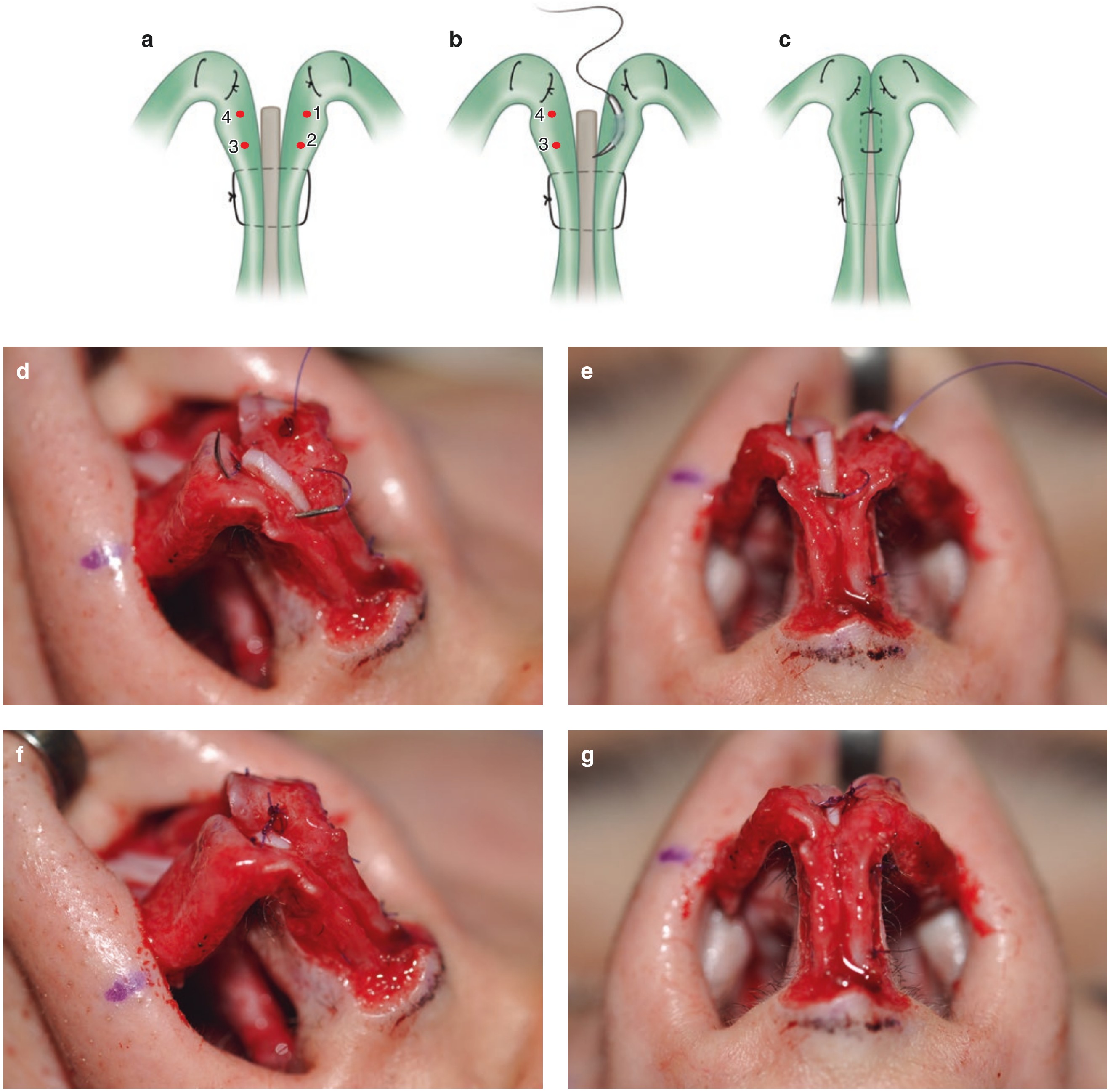


Fig. 2.31 (**a–g**) Interdomal suture (ID)

Because the columellar strut suture and domal creation sutures are already in place, the location of the **interdomal suture (ID)** is virtually predetermined. The suture enters just below the domal creation knot on the left and exits just above the columellar strut suture on the middle crus. Then the needle enters the right crus directly across and exits just below the domal creation knot (Fig. 2.31). The only decisions are how far back from the caudal border to insert the suture and how tight to tie the knot. In general, the suture is placed 2–3 mm back from the caudal border of the crura. If placed too close to the edge, then the columella is too narrow. It is almost impossible to place the suture too far back, because of the columellar strut. The suture is gradually tightened to reduce the interdomal width, not to create a single, pointy tip. Remember the "tip diamond" concept: the normal angle of domal divergence is approximately 30°. Also, the columella flares at its base, narrows at its midpoint, and gradually widens in the infralobule.

MIDDLE CRUS: TIP SUTURES—DOMAL EQUALIZATION

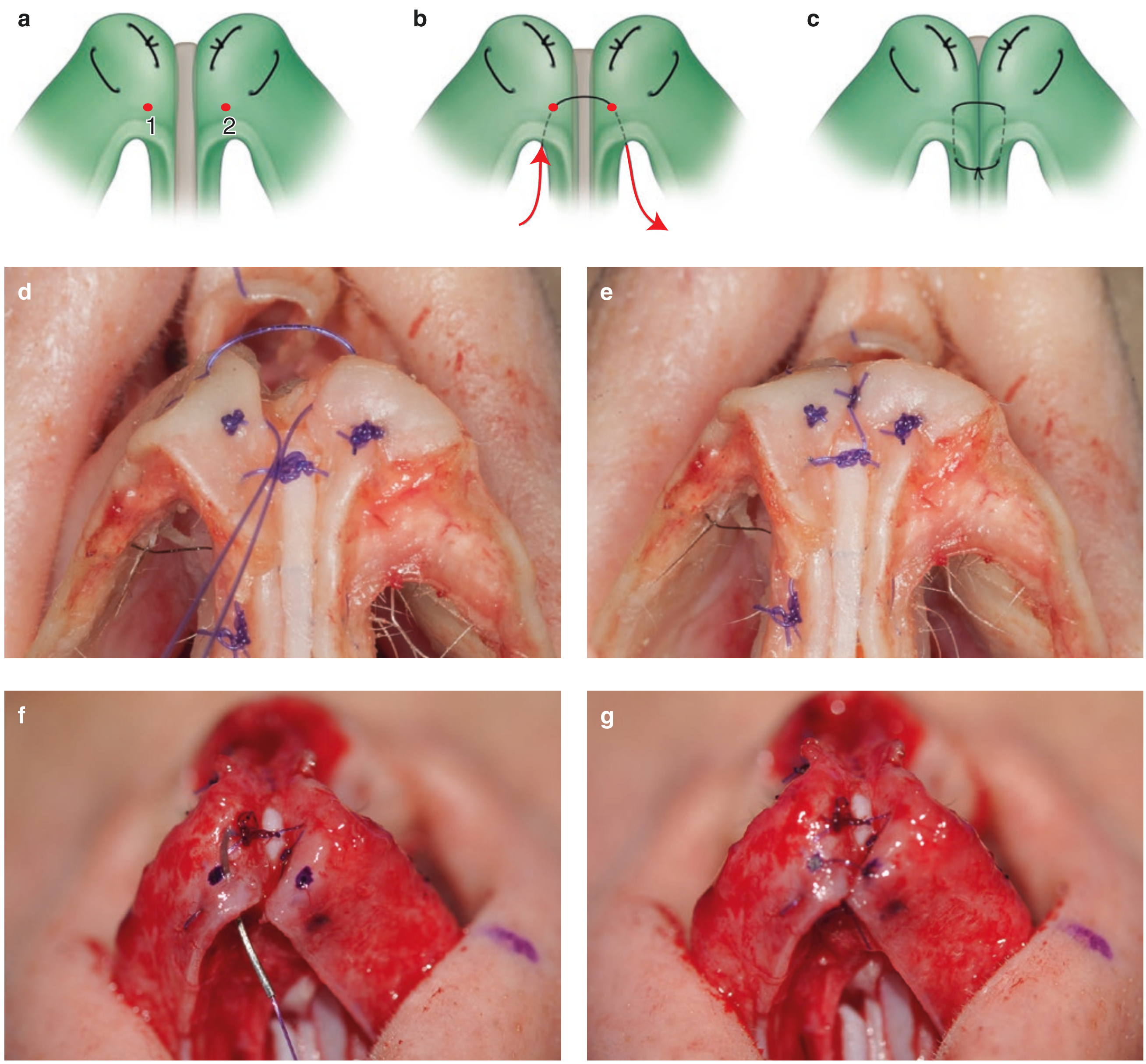


Fig. 2.32 (**a–g**) Domal equalization suture (DE) anatomically in frontal view, clinically in top-down view

Of all the tip sutures, the **domal equalization suture (DE)** is the easiest to insert and the most difficult to do wrong. The needle enters the left dome beneath its cephalic edge, exits 1.5–2.5 mm onto the domal segment, then enters at a comparable point on the right domal segment, and exits beneath the cephalic edge of the left (Fig. 2.32). The knot is then tied until the cartilages touch. The suture brings the cephalic edge of the two convex domal segments together, thus creating the apex of the tip diamond. Equally, it depresses the cephalic border of the rim below that of the caudal border, thus moving the tip-defining point toward the caudal border of the domal segment. This suture is used frequently, but it is not always required. Small differences in placement points are done on either alar to fine-tune symmetry. This suture is surprisingly effective, with minimal risk.

MIDDLE CRUS: TIP SUTURES—DOMAL CREATION (LATERAL CRURAL STEAL)

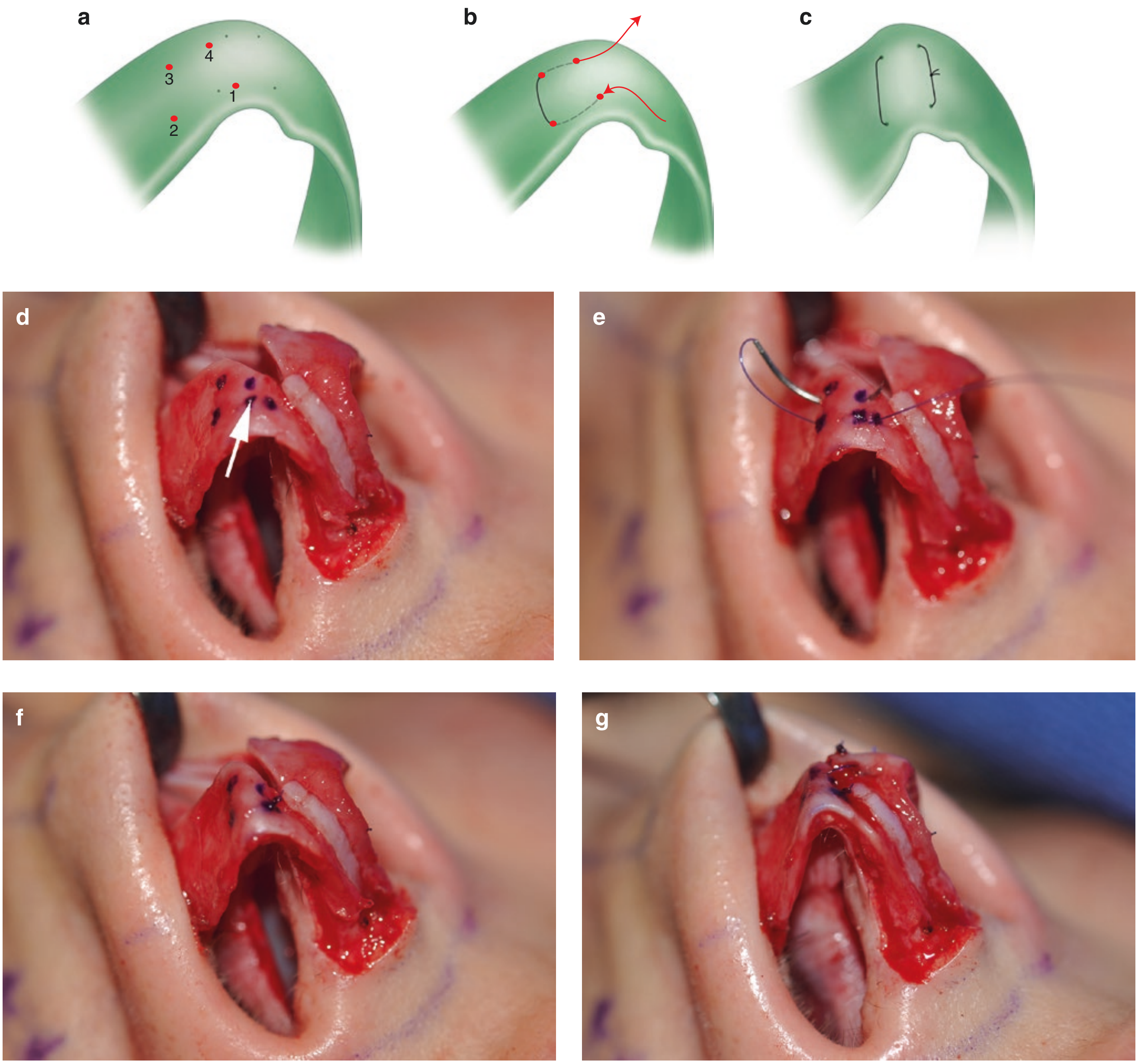


Fig. 2.33 (**a–g**) Lateral crural steal suture (LCS). Surgical technique. *Arrow* indicates the location of the anatomical dome with the LCS lateral to it

The **lateral crural steal suture (LCS)** was devised by Kridel et al. (1989) to increase tip projection and rotation. "Essentially, the LCS is the same as a domal definition suture, but placed lateral to the domal notch… In essence, one is 'stealing' lateral crural cartilage to create a longer medial crura." The critical premise of the LCS is to "advance the lateral crura medially…. This advancement is secured separately on the right and the left by placing a single 5-0 permanent mattress suture through the lateral crus and the transformed anterior medial crus, just below the newly established dome." Unfortunately, this suture is not illustrated diagrammatically in Kridel's articles. Rather, the addition of a Tardy-style transdomal suture was drawn and is often mislabeled as the LCS. One must be careful with the LCS, as the greater the steal, the greater the risk of over-rotation of the tip and a long infralobule (Fig. 2.33).

MIDDLE CRUS: TIP SUTURES—DOMAL CREATION (MIDDLE CRURAL STEAL)

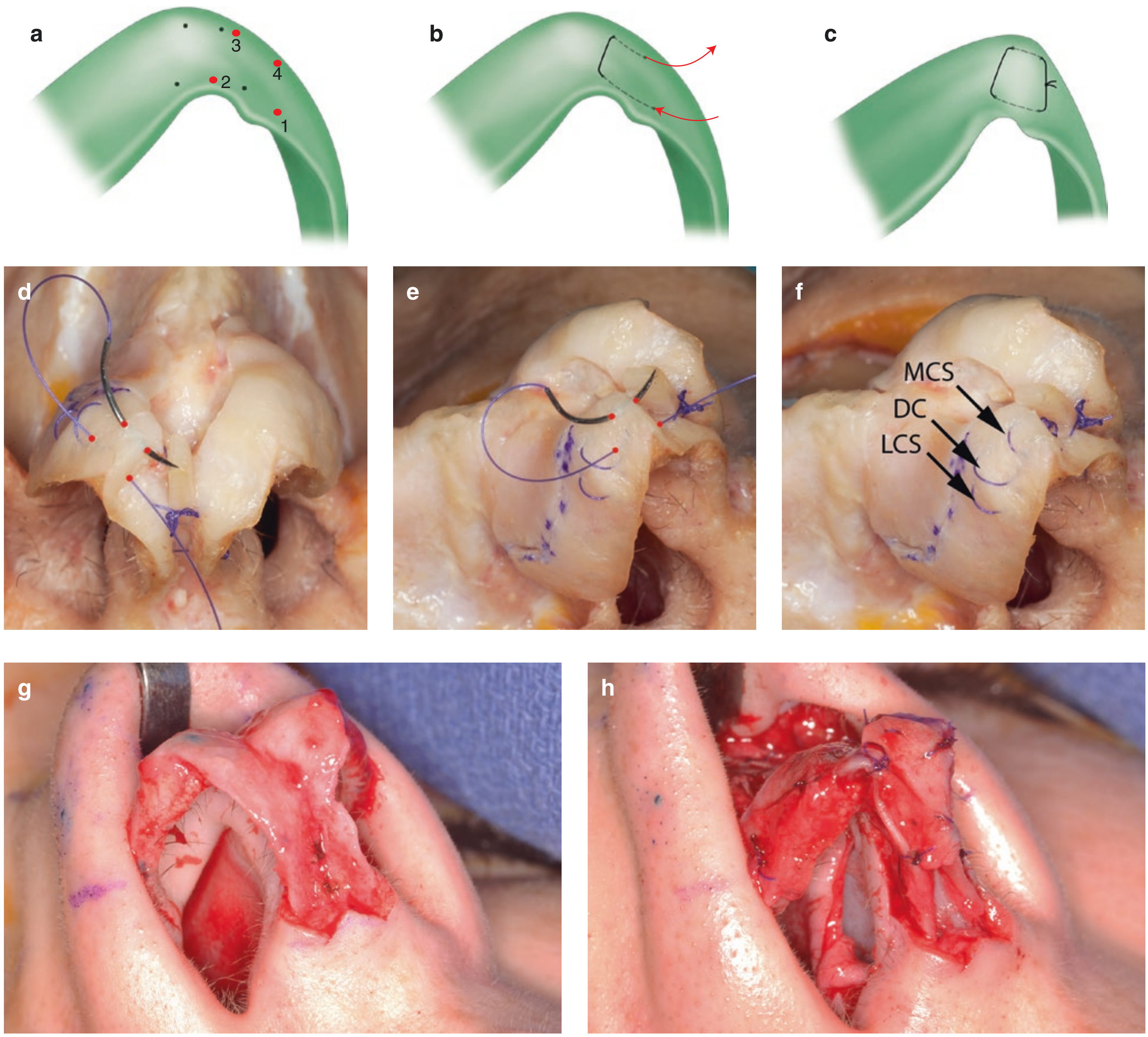


Fig. 2.34 (**a–h**) Middle crural steal suture (MCS). *Red dots* indicate the MCS insertion points. Sutures in (f) indicate localization of the middle crual steal (MCS), domal creation (DC), and latral crural steal (LCS) sutures

Following experience with the LCS suture, it was inevitable that surgeons would devise the **middle crural steal suture (MCS)**. Essentially, the domal creation suture is moved 2–4 mm from the domal notch toward the medial genu, thereby shortening the middle crus (Fig. 2.34). As noted in the cadaver suture sequence (Fig. 2.34 d,e), the domal creation suture is no longer located at the domal notch, but rather is moved medially by 2–5 mm. Clinically, one can shorten a long middle crus by excising a segment of the lobular segment (modified Lipsett technique), which is relatively destructive, in contrast to a simple MCS.

MIDDLE CRUS: TIP SUTURES—DOMAL CREATION (CRANIAL TIP SUTURE)

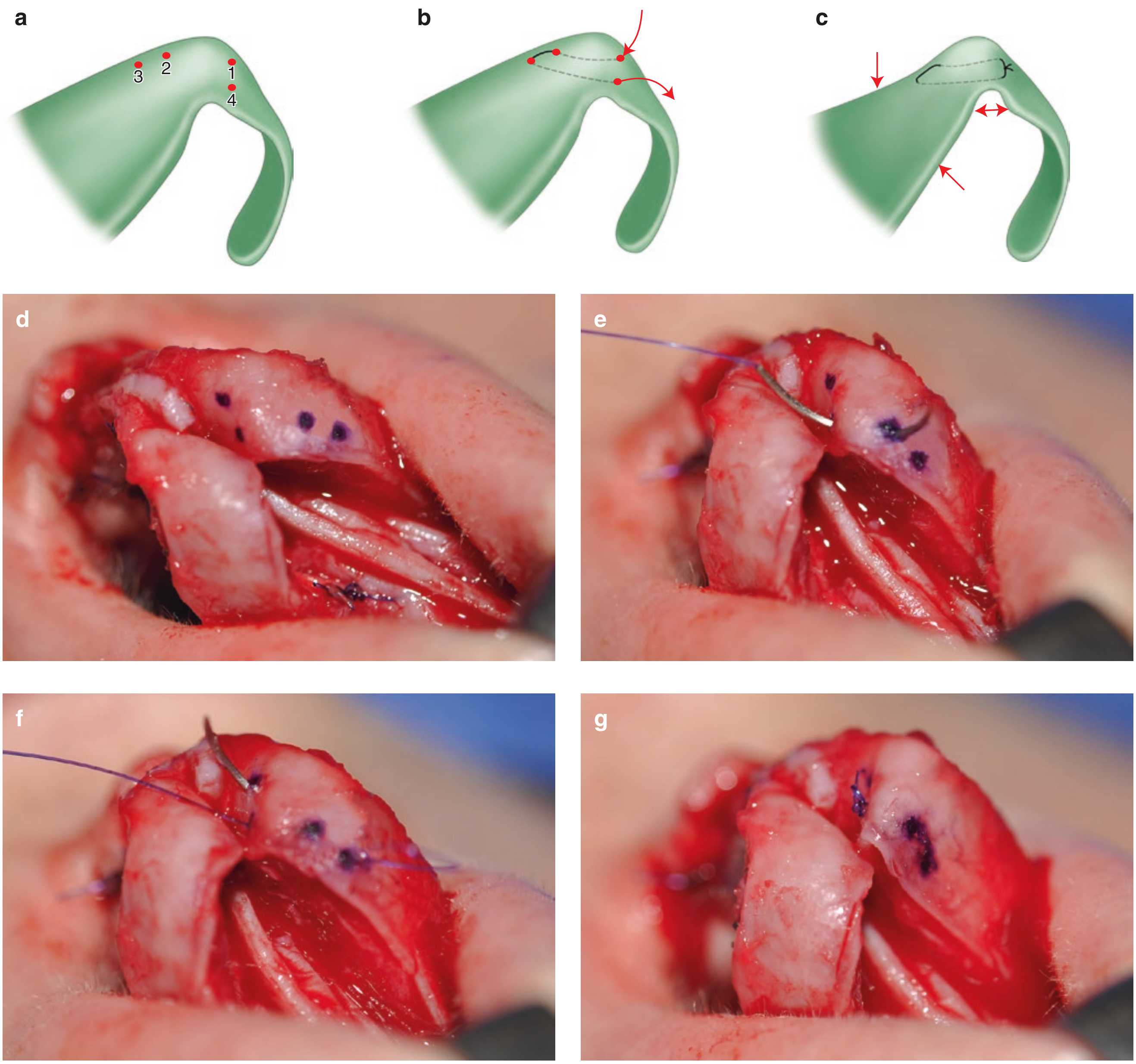


Fig. 2.35 (**a–g**) Cranial tip suture (CTS). The first entry point (1) is 3 mm below the dome and 3 mm from the cephalic edge of the crus. The first exit point (2) is 2 mm beyond the dome laterally and 2 mm from cephalic edge of the lateral crus. The second entry point (3) is placed 2 mm beyond the first exit point (2) and again 2 mm from the cartilage edge. The second exit point (4) is at the same level as (1), but caudal to it. The suture is tied sufficiently tight to create the desired definition

Kovacevic and Wurm (2014) introduced the *cranial tip suture* (CTS) to minimize any unfavorable attributes of the classic domal creation suture. The CTS is a triangulated type of mattress suture, as illustrated in Fig. 2.35. In addition to achieving tip definition, the CTS has three major benefits. First, the caudal margin of the lateral crus is rotated above the cephalic margin, which improves aesthetics and minimizes the need for alar rim grafts. Second, the cephalic tip point is raised relative to the caudal tip point, improving the supratip break. Third, eversion of the soft tissue facet is maintained. With experience, one can modify the needle entry and exit points to achieve even greater finesse.

MIDDLE CRUS: TIP SUTURES—DOMAL CREATION (CEPHALIC DOME SUTURE)

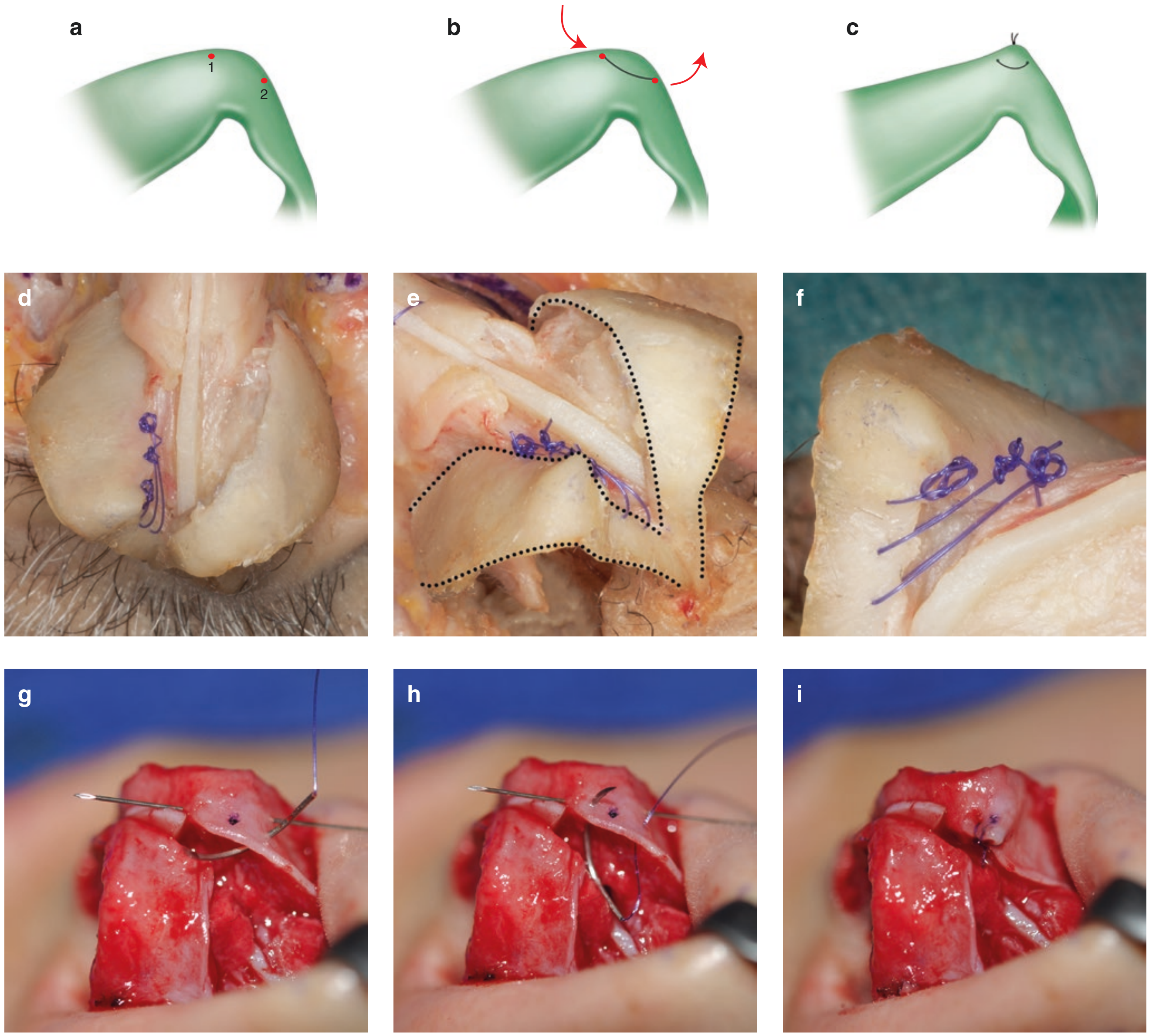


Fig. 2.36 (**a–i**) Cephalic dome suture (CDS)

Dosanjh et al. (2010) described a "hemitransdomal suture" for narrowing the nasal tip. Rather than a four-bite domal creation suture, these authors recommended a suture on the cephalic end of the dome, between the lateral and middle crus, to narrow the dome. The wider the bite, the greater the narrowing. The two advantages were that the lateral crus was not made concave, and the caudal border was everted, thus reducing the need for alar rim grafts. Independently, Çakır (2016) came to a similar conclusion and coined the term ***cephalic dome suture (CDS).*** His method (Fig. 2.36) is as follows:

1. Mark the ideal dome point.
2. Place the CDS 3 mm on either side of the ideal dome point.
3. Tie until the convexity occurs (but not too tight).
4. Add an additional CDS at the 5-mm and 7-mm point as needed.
5. Excise the cephalic dog ear, if necessary.

MIDDLE CRUS: TIP SUTURES—TIP POSITION SUTURE

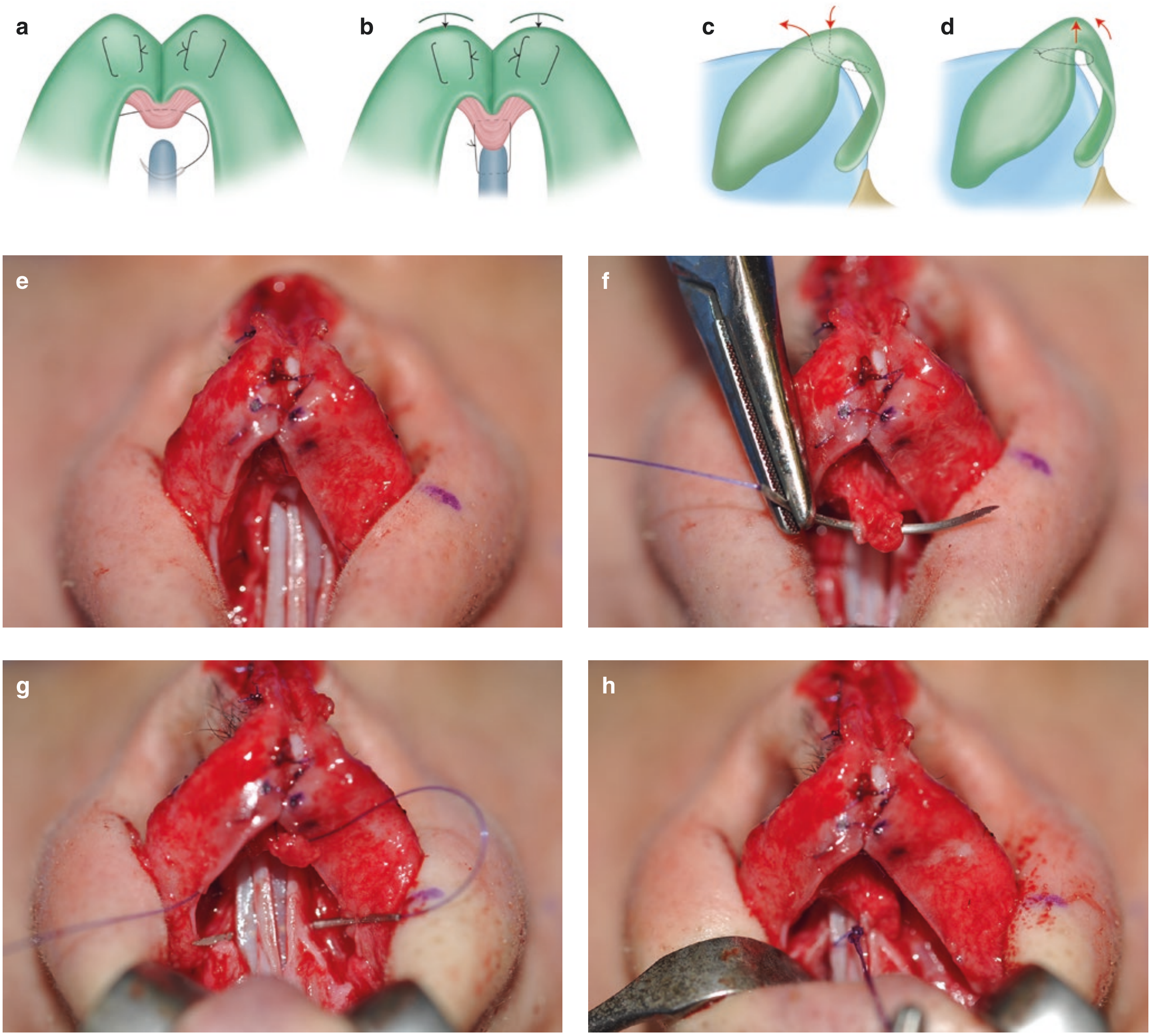


Fig. 2.37 (**a–h**) Tip position suture (TP) between the distal deep portion of Pitanguy's ligament and the anterior dorsal septum

The **tip position suture (TP)** achieves both tip rotation and increased projection, which in turn creates the supratip break that most patients want (Fig. 2.37). It is a simple transverse suture between the distal deep portion of Pitanguy's ligament and the anterior dorsal septum. It is placed from the top through an open approach using 4-0 PDS suture on a medium-size needle (FS2). As the knot is tightened, the tip rotates upward and projects above the dorsal line, creating a supratip setoff. Early on, one should do a single throw, redrape the skin, and assess its effect: Care is needed because over-rotation is a disaster. The TP is the most powerful of tip sutures, so do not over-tighten—If in doubt, take it out! After 25 years of experience with this suture, the TP remains the critical suture for achieving finesse in tip rotation and projection that results in attainment of a supratip break (Daniel 1992).

MIDDLE CRUS: COLUMELLAR–SEPTAL SUTURE

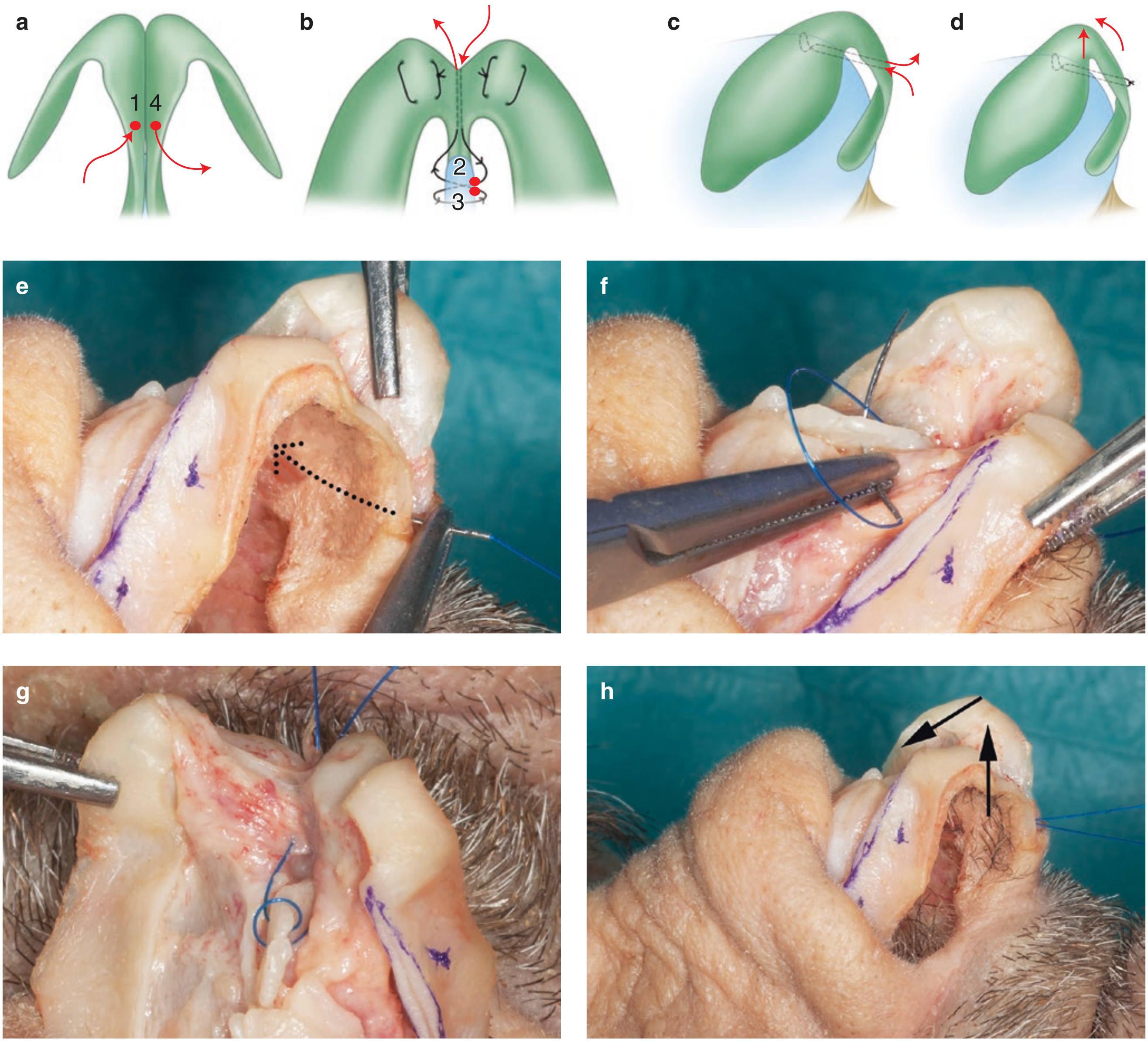


Fig. 2.38 (**a**–**h**) Columellar-septal suture

Joseph (1987) and Fred (1950) described the columellar–septal suture as done through the transfixion incision (Fig. 2.38). We continue to use it for minor adjustments in projection (1–2 mm), as well as for transitory support during wound healing. A 4-0 PDS is used to suture the back of the columella to the caudal septum. Gruber (2014) has adapted this suture to the open approach. A 4-0 PDS suture is passed between the medial crura, up to the anterior septal angle. Two bites of the septum are taken to ensure stabilization, and then the needle is passed back between the medial crura, where the knot is tied. If the suture causes the medial crus to flare, one can add an intercrural suture to narrow the columella.

MIDDLE CRUS: INTRINSIC TIP PROJECTION

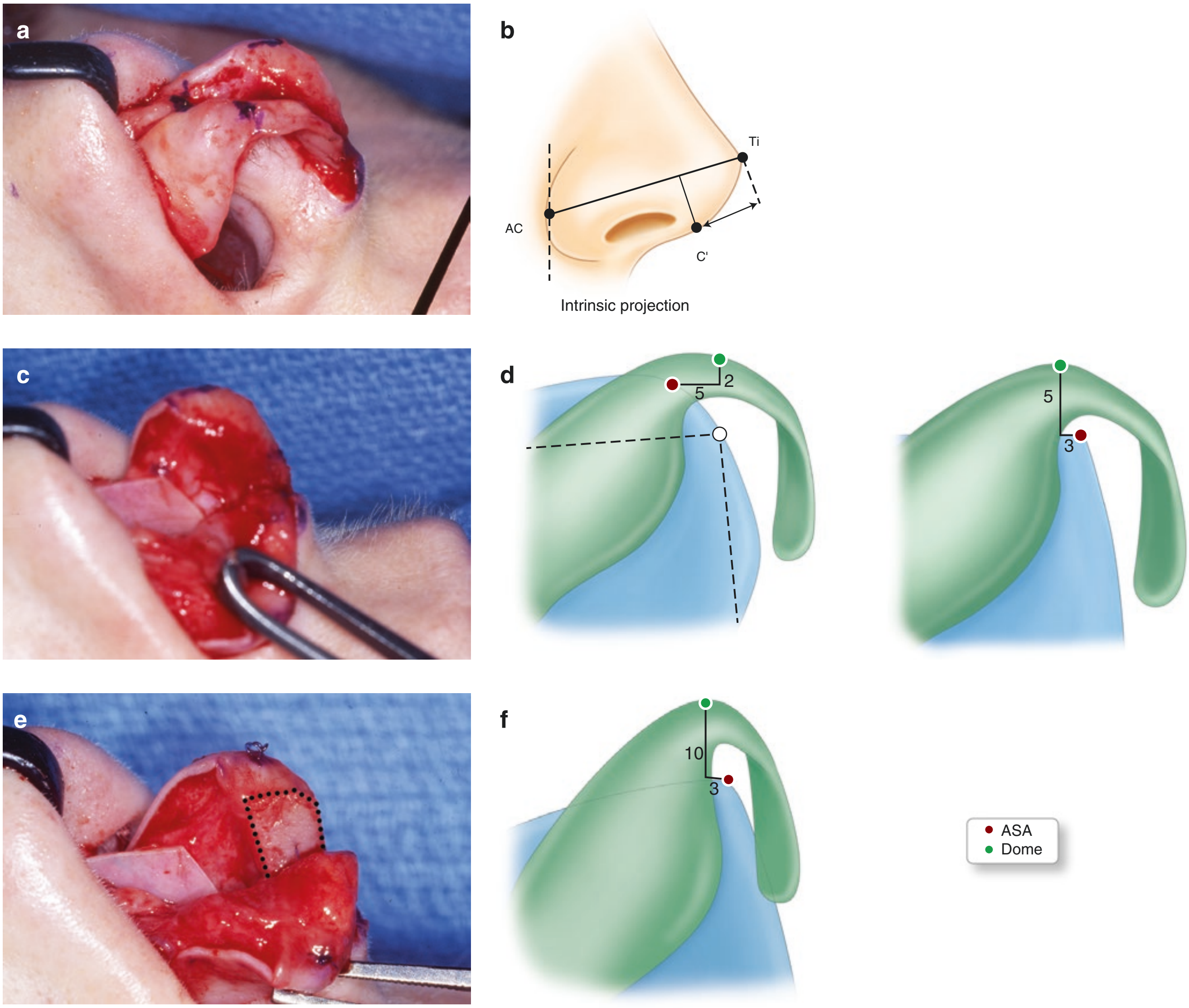


Fig. 2.39 Change in intrinsic tip projection. (**a**, **b**) The domes are 5 mm caudal and 2 mm above the ASA. (**c**, **d**) Following a 5-mm dorsal reduction and a 3-mm caudal septal resection, the new relationship is domes 3 mm proximal and 5 mm above the ASA. (**e**, **f**) The alar cartilages are sutured to the columellar strut, followed by DC, ID, and DE sutures; the domes are now 3 mm cephalic and 10 mm above the ASA. A unilateral left columellar suture remains in place (**e**)

The intraoperative photographs in Fig. 2.39 show the progressive change in domal projection relative to the anterior septal angle (ASA). The major change in the dome/ASA relationship in Fig. 2.39a–d is due to excision of *extrinsic factors*. Next, the alar cartilages were sutured to the columellar strut, followed by DC, ID, and DE sutures. The final change is an impressive 8 mm of shortening and an 8-mm gain in projection of the domes relative to the ASA.

MIDDLE CRUS: SUTURES (CASE STUDY)

Analysis: A 28-year-old woman presented with the classic three complaints: a bump on profile, a bulbous tip that plunged, and an overall heavy nose. She wanted a really cute nose.

Operative Technique **(**Fig. 2.40**)*:***

1. An open approach with maximum soft tissue excision over the tip
2. Incremental dorsal reduction (B 0.5 mm, C 4.0 mm). Caudal septal resection 2.5 mm
3. Medial oblique and mid-level intermediate osteotomies, no lateral
4. Tip sutures: CS, DC, ID, DE, TP, lateral crural convexity sutures (LCCS)
5. Nostril sill excisions (2.5 mm) and alar rim grafts

Commentary: At 4 years postop, the tip has maintained its definition (DC), narrowing (ID), decreased bulbosity (LCCS), and projection/rotation (TP). In all four views (Fig. 2.41), there is a marked permanent improvement in the nasal tip/lobule. Note: all intraoperative photographs are taken with a fixed lens camera and are directly comparable as to size.

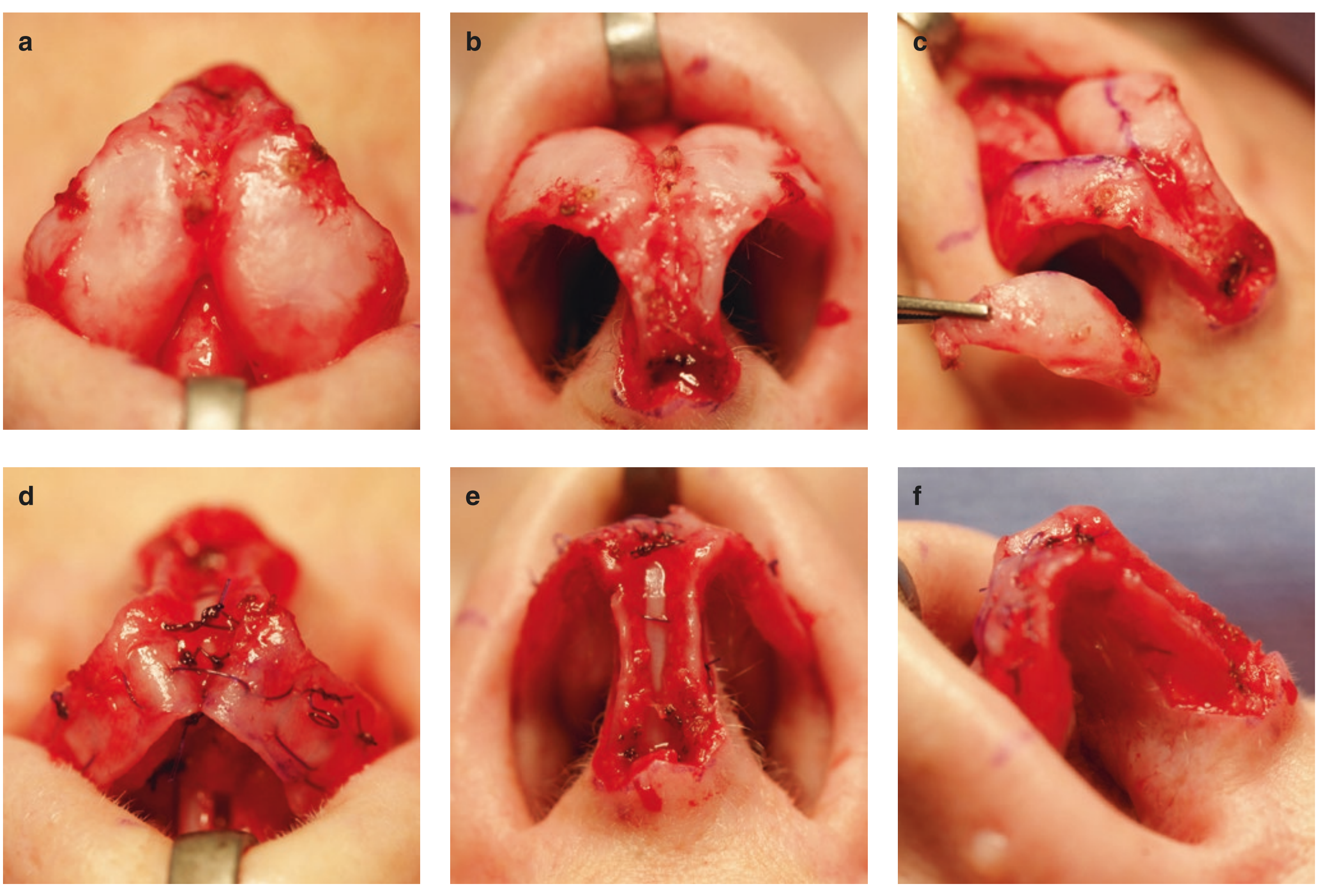


Fig. 2.40 (**a**–**f**) Middle crus sutures

MIDDLE CRUS: SUTURES (CASE STUDY)

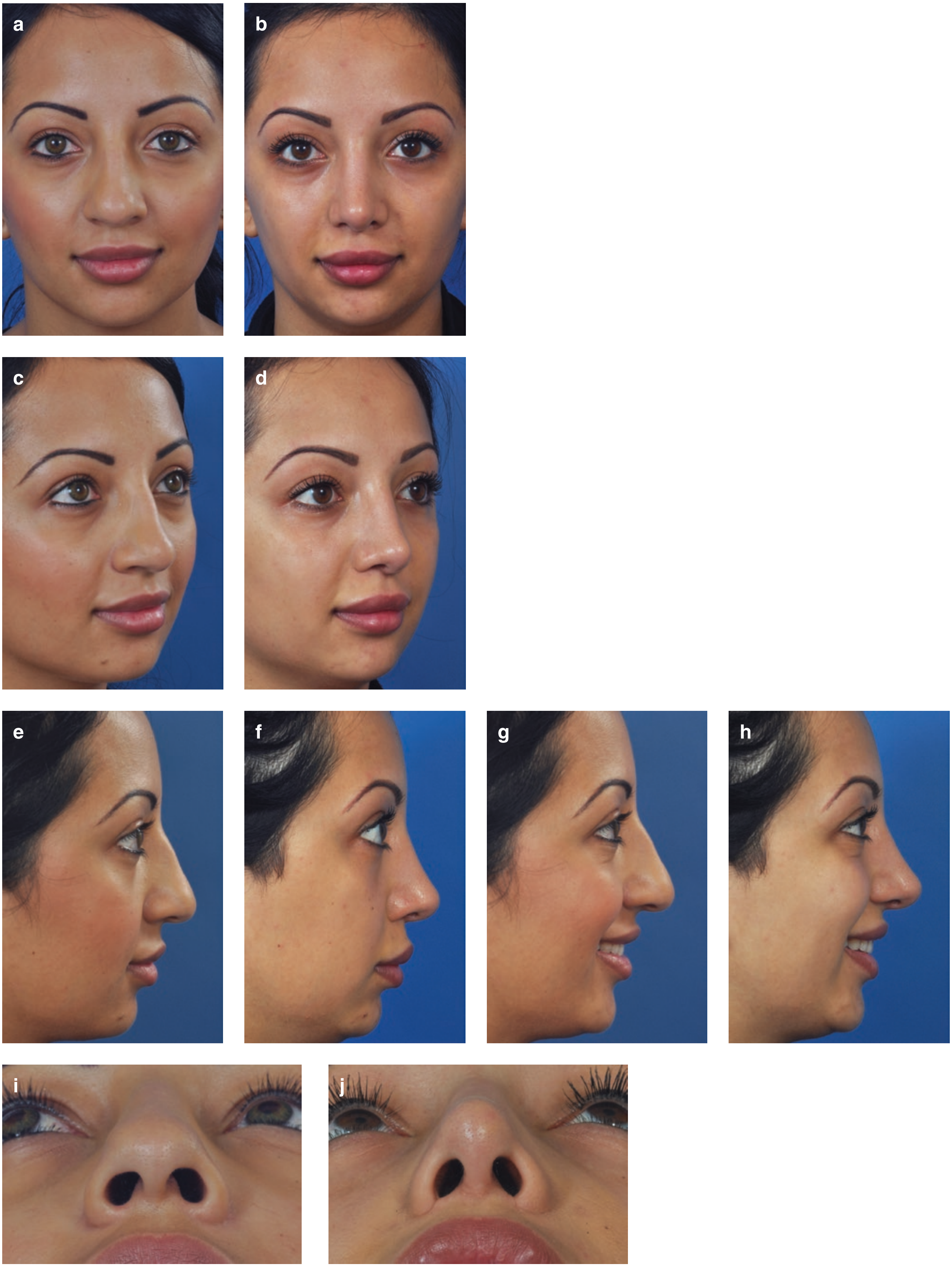


Fig. 2.41 (**a–j**) Case study patient before (*left*) and 4 years after (*right*) using middle crus tip sutures

MIDDLE CRUS: SUTURES AND TIP REFINEMENT GRAFTS (CASE STUDY)

Analysis: A 22-year-old patient presented with the complaint that her nose looked heavy and didn't match her personality. She felt that her tip was a "blob" that lacked definition and plunged on smiling. Obviously, the thick skin was a major factor.

Operative Technique (Fig. 2.42):

1. An open approach with limited soft tissue defatting.
2. Minimal dorsal reduction (B 0.5, C < 2.0). No resection at ASA.
3. Caudal septal (4 mm) and ANS resection. Septal harvest.
4. MO and LL osteotomies. Bilateral spreader grafts.
5. Tip sutures: CS, DC, ID, DE, LCCS. Add-on folded TRG.
6. 3-mm nostril sill excisions. Followed by alar rim structure grafts.

Commentary: At 2 years postop, there has been significant improvement in the patient's appearance (Fig. 2.43). Tip correction required two major changes: a reduction in tip width using lateral crural convexity sutures (Fig. 2.42 b,c) and an increase in *intrinsic* tip projection using tip sutures and a columellar strut. The tip refinement graft creates more "show" and definition through the thick skin envelope.

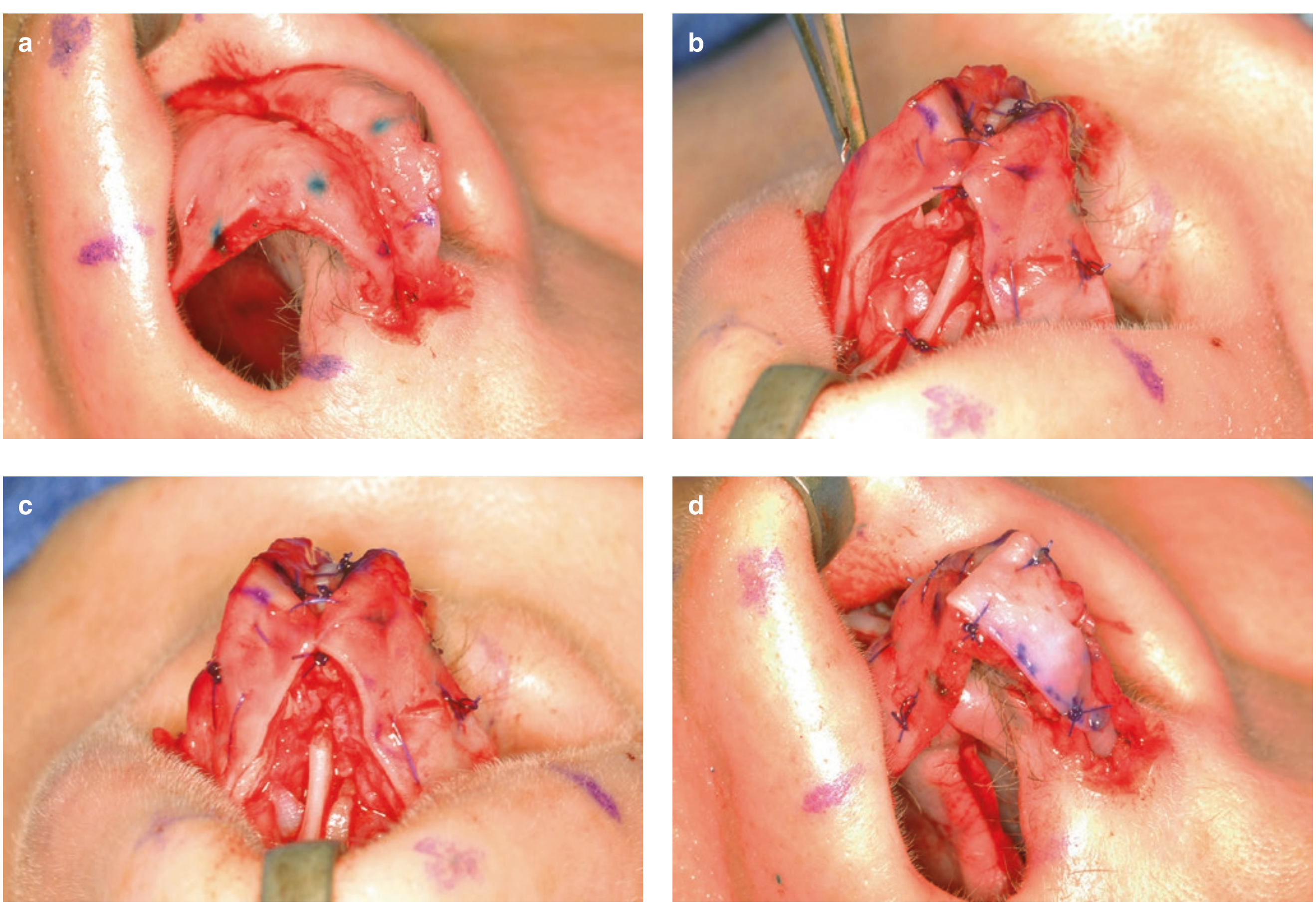


Fig. 2.42 (**a–d**) Tip refinement graft

MIDDLE CRUS: (CASE STUDY)

Fig. 2.43 (**a–j**) A thick skin patient before (*left*) and 2 years after (*right*) correction using middle crus tip sutures and tip refinement grafts

LATERAL CRUS: AXIS

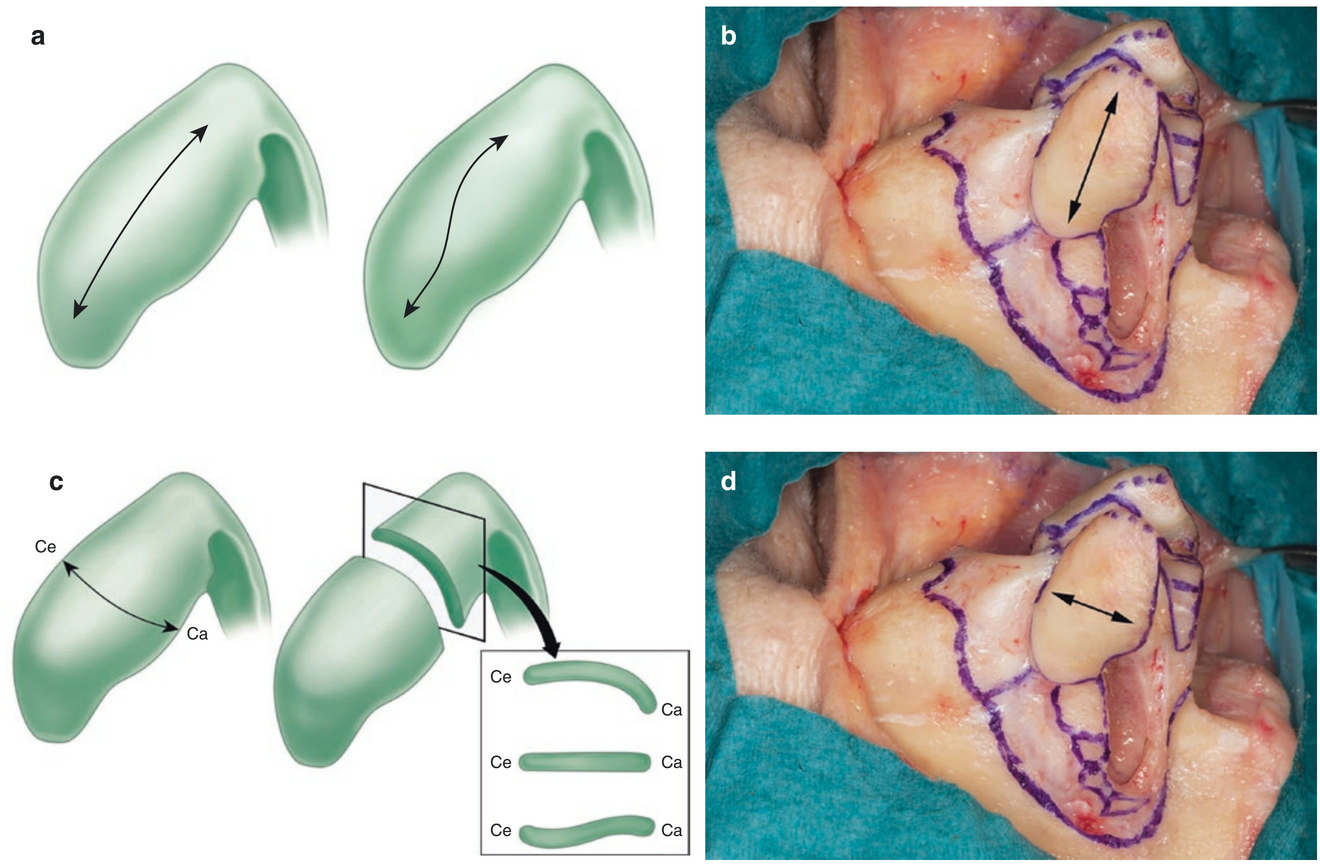


Fig. 2.44 (**a**, **b**) Transverse axis and (**c**, **d**) vertical axis of the lateral crus. CA—caudal border; CE—cephalic border

As defined by Johnson and Toriumi (1990), the lateral crus has a ***transverse*** (horizontal) and a ***vertical*** axis (Fig. 2.44). In the majority of rhinoplasties, a variable amount of the cephalic portion of the lateral crus is excised. Classically, this excision was made to improve tip appearance by reducing volume, narrowing width, and increasing definition. With the rise of open-tip suture techniques, it has become apparent that incision/excision of the lateral crus also increases the malleability of the remaining alar cartilage. In our clinical study, we observed that incision followed by excision of excess lateral crus resulted in a more horizontal, flat rim strip with dramatic changes in the relative levels of the cephalic and caudal borders (Daniel et al. 2014). *In an aesthetic tip, the caudal border should be above the cephalic border of the lateral crural rim strip.* The reader should carefully study Fig. 2.44c and note how the caudal border is above the cephalic border and the intervening cartilage is slightly concave – an ideal aesthetic configuration. Excising a portion of the cephalic lateral crura yields positive effects in most cases, but on occasion the simple act of excision can accentuate a lateral crural convexity. Gruber's et al. (2005) lateral crura mattress suture has proven extremely effective both in neutralizing convexities and bringing a prominent cephalic border back to a horizontal level.

LATERAL CRUS: SHAPE

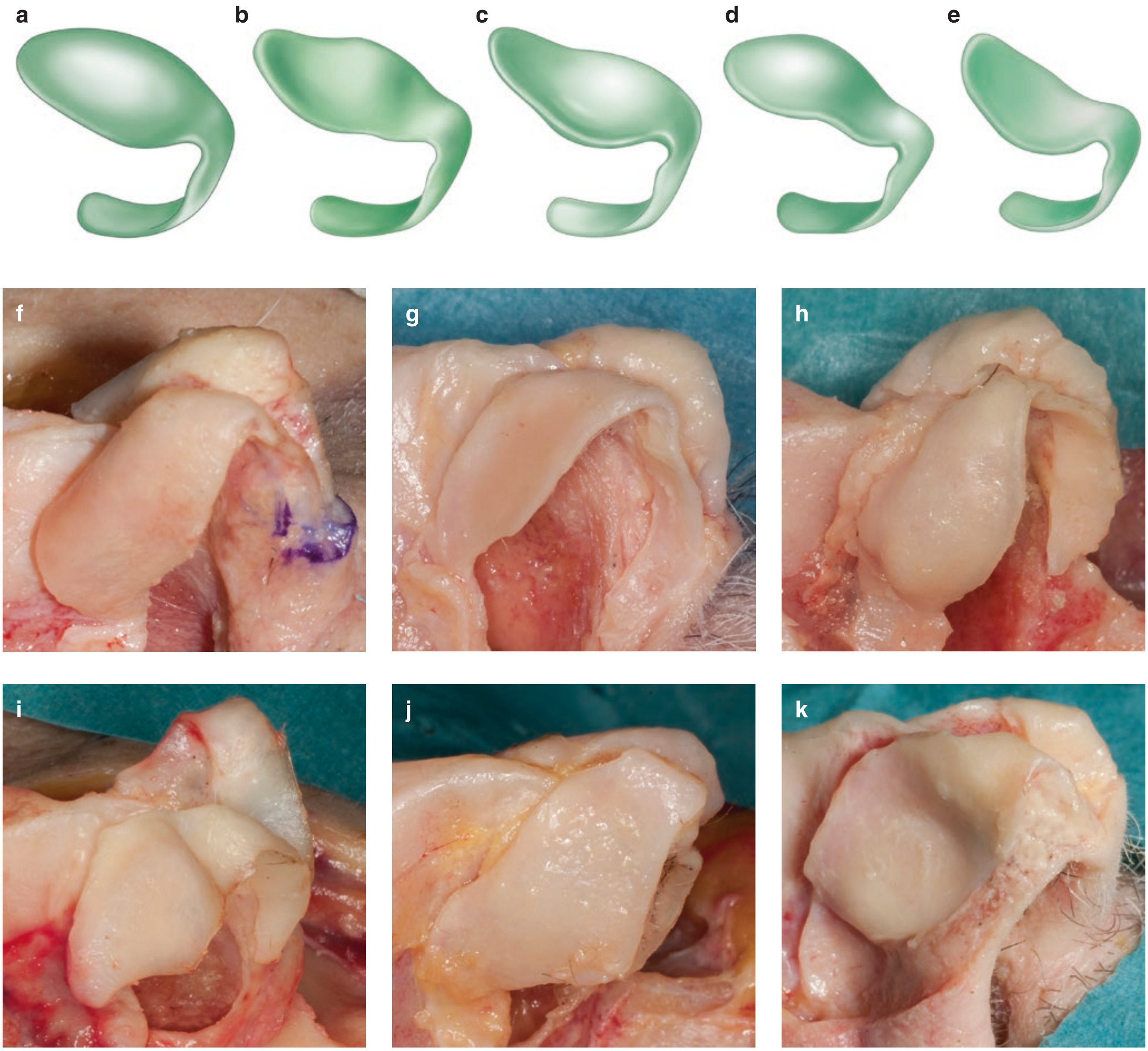


Fig. 2.45 (**a**–**e**) Different shapes of the lateral crus. (**f**) Straight/convex, (**g**) straight/concave, (**h**) convex/convex, (**i**) concave/concave, (**j**) concave-straight/straight, (**k**) concave-convex/concave shapes of the lateral crus in the transverse and vertical axes

The shape of the lateral crus can be classified using a the convex-smooth-concave terminology of Zelnik and Gingrass (1979). It is applied on both the transverse (horizontal) and vertical axes. Though Zelnik and Gingrass classified the lateral crus inclusive of the domal segment, our description pertains just to the lateral crus, where the shape on the ***transverse axis*** varies as follows: (1) smooth-straight, (2) convex, (3) concave, (4) smooth-convex, and (5) convex-concave-convex (Daniel et al. 2011). The shape on the ***vertical axis*** varies as follows: (1) smooth-straight, (2) convex, (3) smooth-convex, (4) concave, and (5) convex-concave-convex. During surgery, dramatic changes occur in the shape of the lateral crus. Excising a variable amount of cephalic lateral crus has three effects: It creates a "new" cephalic border, it changes the cephalic-caudal border relationship, and it alters both shape vectors (Fig. 2.45).

LATERAL CRUS: BORDERS

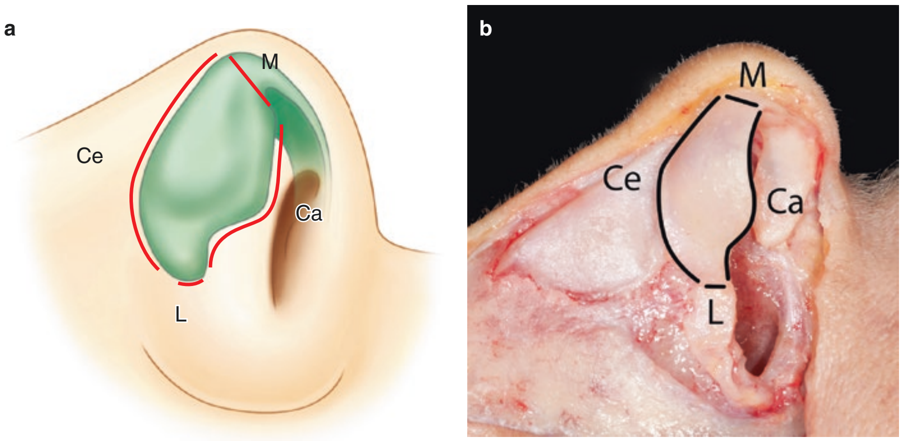


Fig. 2.46 (**a**, **b**) Cephalic (Ce), medial (M), caudal (Ca), lateral (L) borders of the lateral crus

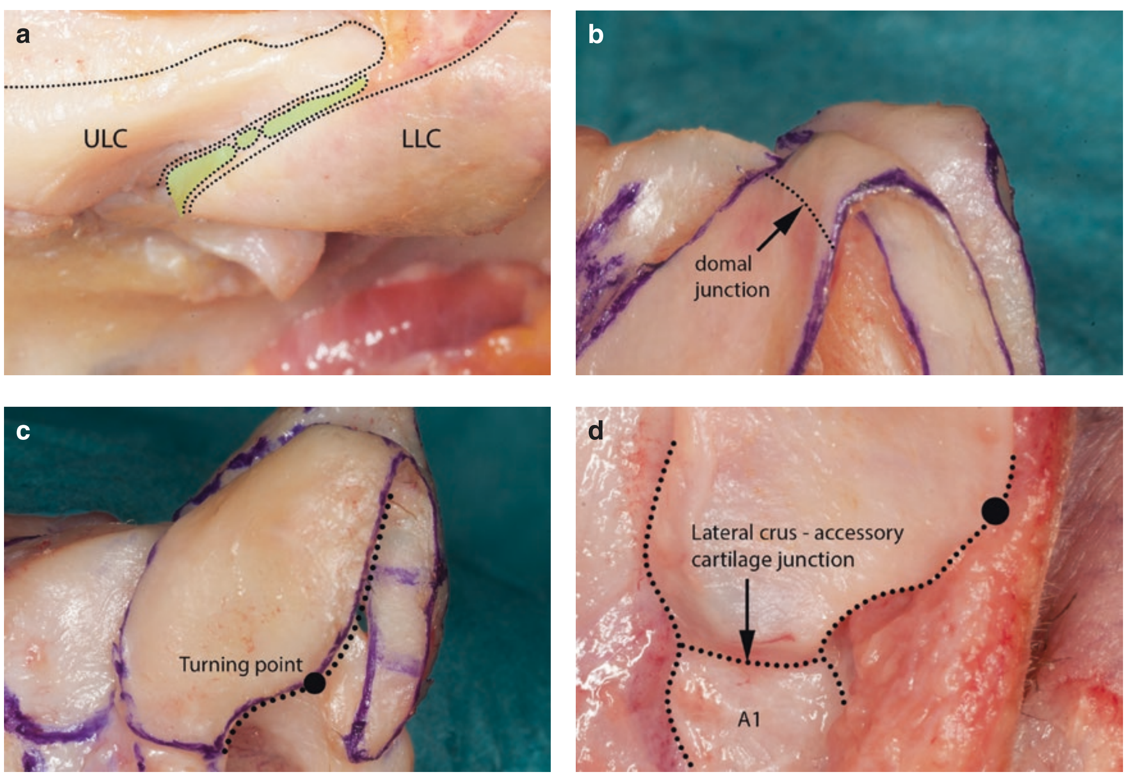


Fig. 2.47 (**a**) Cephalic, (**b**) medial, (**c**) caudal, and (**d**) lateral borders of the lateral crus. A1—first accessory cartilage; LLC—lower lateral cartilage; ULC—upper lateral cartilage

The best method of assessing the lateral crus is to analyze its four borders: medial, lateral, caudal, and cephalic (Figs. 2.46 and 2.47) (Daniel 1992). The ***medial border (M)*** occurs at the domal junction with the domal segment of the middle crus. The ***cephalic border (Ce)*** of the lateral crura has an S-shaped scroll junction with the upper lateral cartilage. The most medial part of the cephalic border rises above the level of the cartilaginous dorsum and changes its direction from transverse to sagittal. This fibrous junction includes fusiform and small, round, interspersed sesamoid cartilages. As the cephalic border extends laterally from the upper lateral cartilages, it becomes isolated in juxtaposition to the mucosal space (Daniel and Letourneau 1988). The ***caudal border (Ca)*** often parallels the nostril rim before turning cephalically at the *turning point* of the lateral crus. In certain cases, the caudal border is distinctly visible as the alar groove. The ***lateral border (L)*** occurs at the junction of the lateral crus with the first accessory cartilage (A1).

LATERAL CRUS: BORDERS

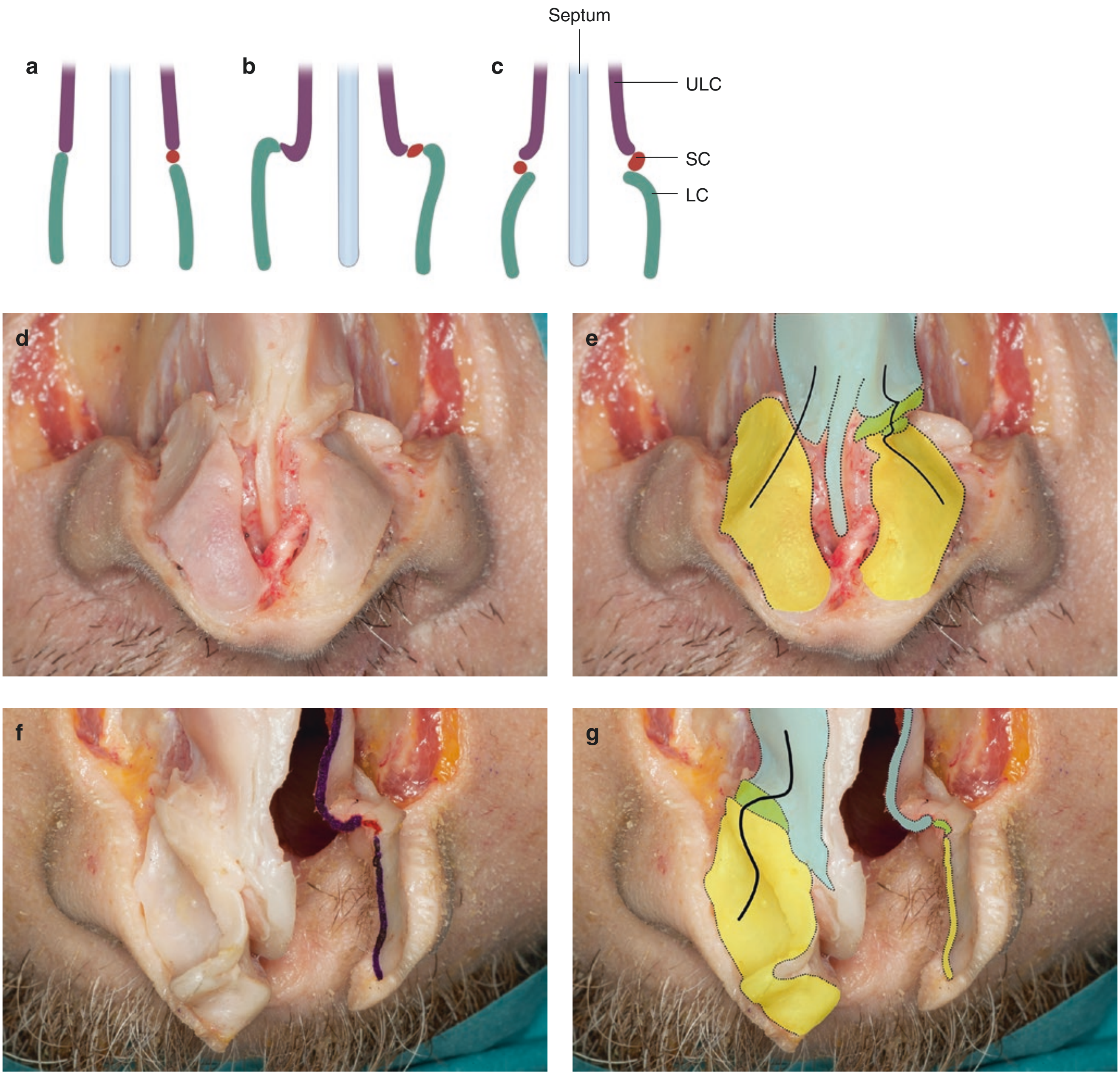


Fig. 2.48 "Scroll" junction of the cephalic border of the lateral crus and the caudal border of the ULC. Types of the scroll junction include (**a**) appositional, (**b**) over-riding, and (**c**) under-riding. (**d**, **e**) appositional and under-riding scroll junction in the same patient (**f**, **g**) S-shape scroll junction with interspersed scroll cartilage (*green*). LC—lateral crus; SC—scroll cartilage

The cephalic border of the lateral crus usually has an S-shaped junction with the caudal border of the upper lateral cartilage (Fig. 2.48). The actual scroll area can vary from this common S-shape to appositional to an inverted, under-riding pattern. The S-shape junction commonly contains small, fusiform, intervening sesamoid cartilages (Drumheller 1973). The appositional and under-riding types of junction are very rare and usually are related to a straight or convex lateral crus on the vertical axis. The S-shape junction plays a major role in breathing, because it helps to form the internal valve. The outward curling of the upper lateral cartilage and the inward curling of the lateral crus create the valve.

LATERAL CRUS: ACCESSORY CARTILAGES

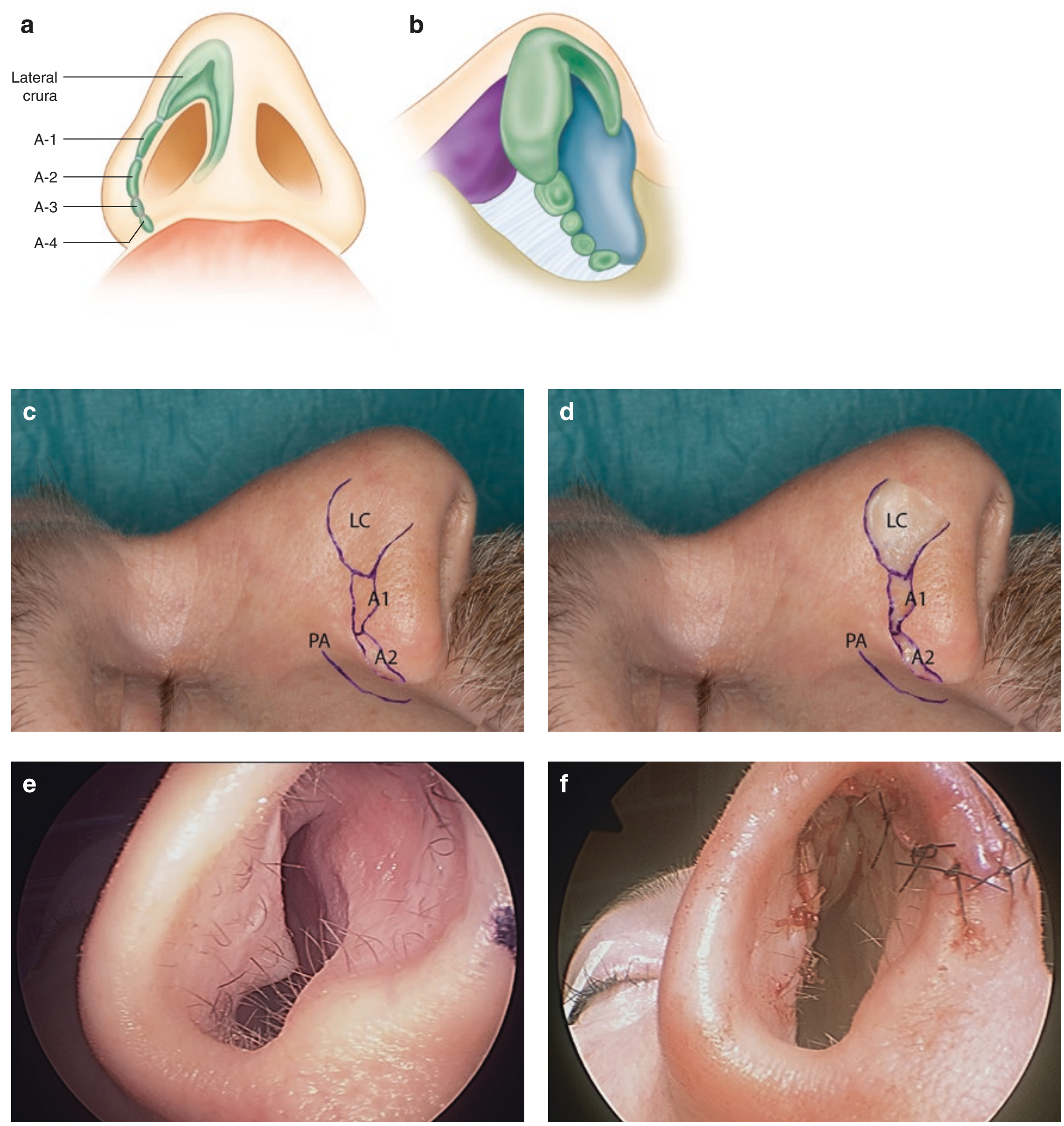


Fig. 2.49 (**a**–**d**) Accessory cartilages (A1–A4) and their exact position under the surface as confirmed with fix positioned sequential photographs. (**e**, **f**) Cottle's vestibular baffle created by the junction of lateral crus and A1. PA—pyriform aperture

The accessory cartilages chain begins at their junction with the lateral crus of the lower lateral cartilage (Fig. 2.49). The number of the accessory cartilages varies from one to four. It must be emphasized that the lateral crus–accessory cartilage complex does not rest on the pyriform aperture, as the tripod concept would indicate. Anderson (1969) devised the "tripod" analogy as a teaching concept for tip surgery. Anderson suggested that the lower lateral cartilage complex forms a tripod, anchored centrally by the conjoined medial crura and laterally by the lateral crura, which "extend to or near the pyriform aperture." The alar cartilage and accessory cartilages constitute a ring around the vestibule with adherence to the vestibular skin and mucosa, which functions as a dynamic baffle to help regulate airflow through the nose. The junction of the A1 accessory cartilage and lateral crus is a constant, functional entity. Their junction creates Cottle's (1955) vestibular baffle intranasally and is often indicated on the skin surface by the alar dimple. As seen in Fig. 2.49e, f, the lateral crus–accessory cartilage junction has buckled into the vestibule, creating nasal obstruction, as seen in this secondary rhinoplasty patient. Surgical correction involved direct excision with underlay of a lateral crural strut graft made of rib cartilage.

LATERAL CRUS: ACCESSORY CARTILAGES

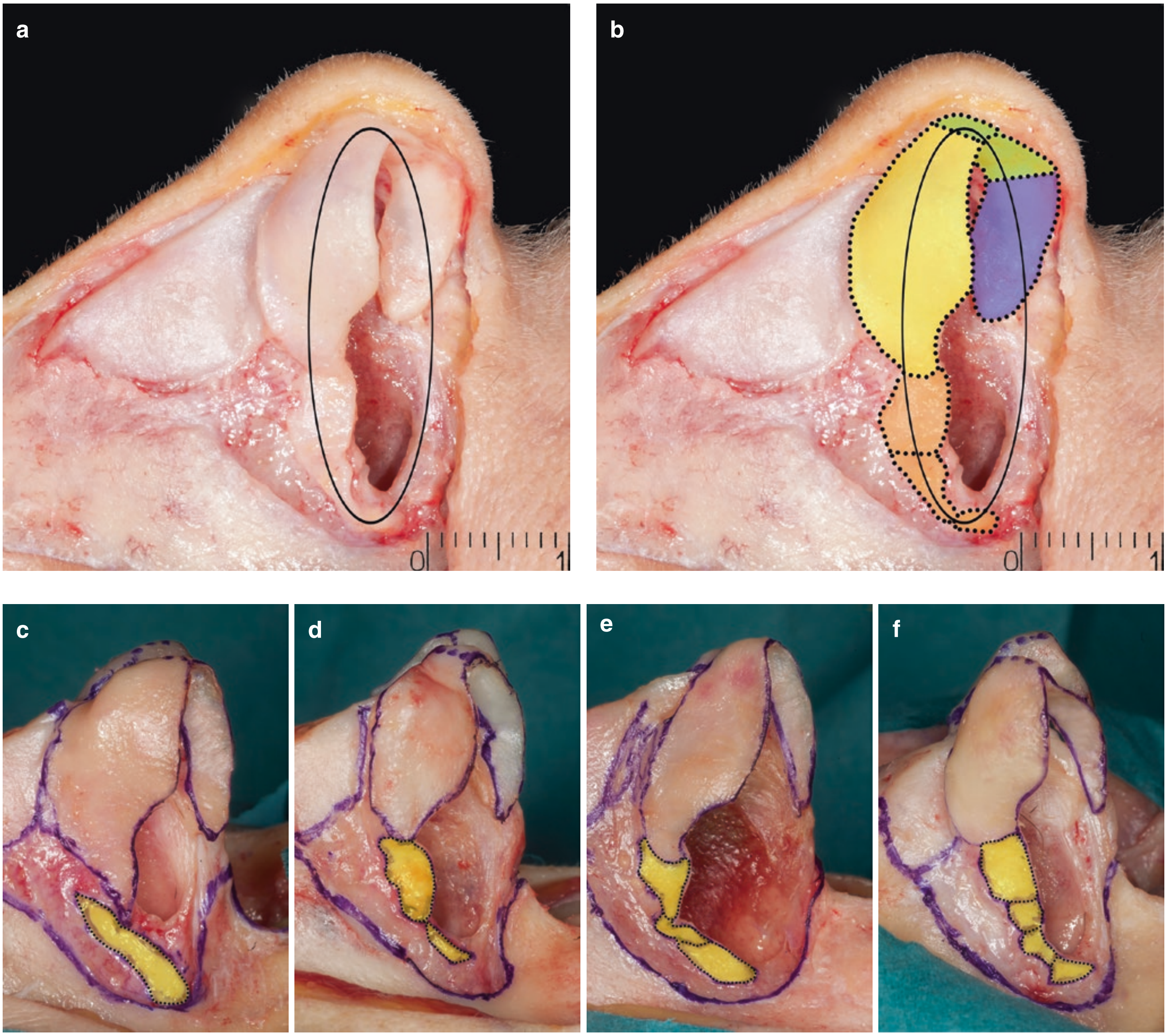


Fig. 2.50 (**a**, **b**) Alar cartilage–accessory cartilage ring. (**c**–**f**) Accessory cartilages vary in number from one to four

The shape and location of the accessory cartilages is influenced more by their direct attachment to the underlying vestibular skin, rather than the overlying surface skin with its intervening muscles (Fig. 2.50). Although the number of accessory cartilages varies, the total length of the cartilages is relatively constant; the fewer the cartilages, the longer they are individually. Usually the A1 accessory cartilage is the largest, and it can be quite large. For this reason, the *Nomina Anatomica* differentiates it from the lower lateral cartilage by using the term *minor alar cartilage*. The mucosal space, which is overlaid by the pyriform ligament (Rohrich et al. 2008) and the belly of the transverse nasalis muscle, acts as the bellows of the nose. The dynamic aspect is ensured by the muscle, and the relative stability is provided by the pyriform ligament.

LATERAL CRUS: ALAR MALPOSITION OF THE LATERAL CRUS

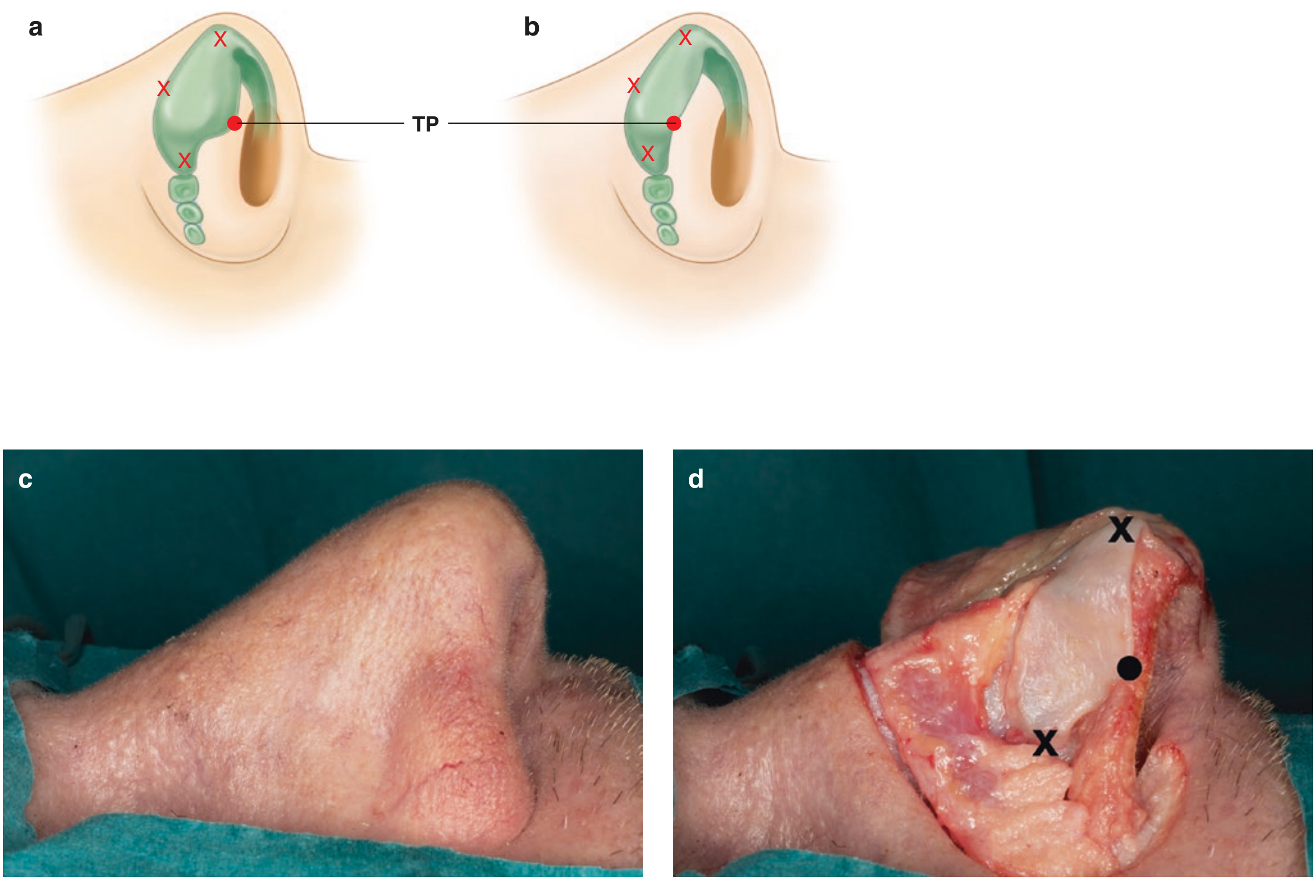


Fig. 2.51 (**a**, **b**) Lateral crus in normal position and in alar malposition. (**c**, **d**) Normal position of the lateral crus. TP - turning point

Sheen (1978) introduced the concept of alar malposition of the lateral crus (Fig. 2.51). His definition of the ***normal position*** was that "most often the caudal edge of the lateral crus is parallel to the alar rim for half the length of the nostril," whereas ***malposition*** is "any displacement of the lateral crus from its usual parallel alignment with the nostril rim." Subsequently, Constantian (1993) began to emphasize "cephalic orientation" of the lateral crus; that is, the transverse axis is rotated cephalically away from the lateral canthus and more towards the medial canthus. Daniel (1991) observed that the surface appearance of alar malposition may simply reflect the shape of the transverse axis of the lateral crus (convex, concave) rather than a true positional or orientation deformity. In alar malposition, three critical points remain in their normal position: the origin, termination, and scroll junction of the lateral crus are never altered. It is only the caudal border of the lateral crus that is cephalically oriented. The lateral crus has the same starting point at the domal junction, the same termination point at the junction with the A1 accessory cartilage, and the same scroll junction cephalically. Thus, the only variables are the position, orientation, and shape of the lateral crus. To assess ***position***, the distance of the caudal border of the lateral crus from the mid-nostril point on the alar rim back ranges from 3 to 9 mm. Any distance greater than 7 mm is considered alar malposition (Daniel et al. 2014). With an open approach, it is possible to measure ***cephalic orientation*** of the lateral crus relative to the midline. The most obvious axis to use is the caudal border of the lateral crus, for three reasons: (1) it reflects the pathology of the problem, (2) it is unaltered by excision of the cephalic lateral crus, and (3) its location is modified surgically to correct the problem, in cases of severe malposition.

LATERAL CRUS: ALAR MALPOSITION OF THE LATERAL CRUS

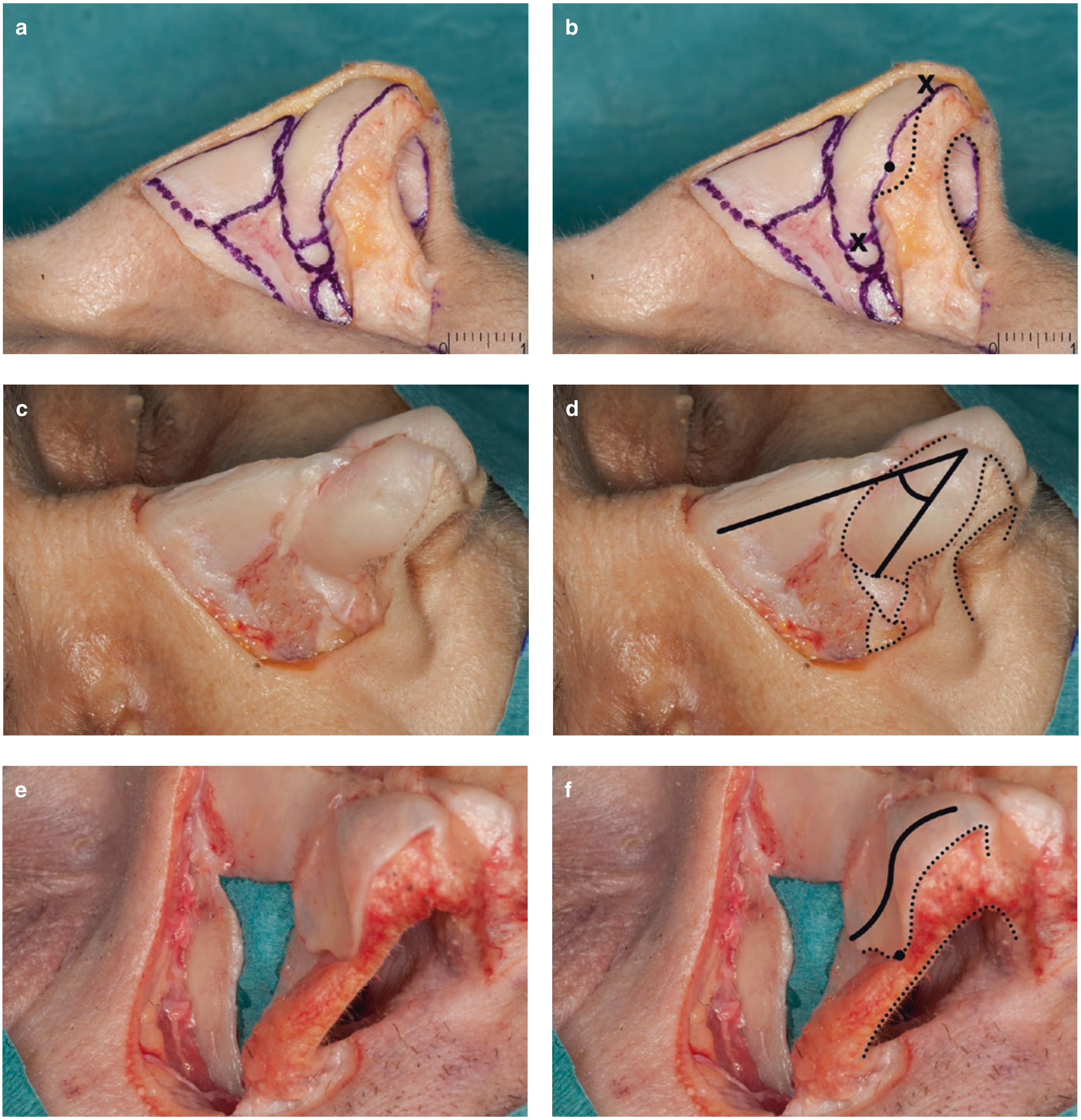


Fig. 2.52 Three etiologies of alar malposition. (**a**, **b**) Positional alar malposition. (**c**, **d**) Cephalic orientation–related alar malposition. (**e**, **f**) Shape-related alar malposition. Note: the caudal border can be far away from the nostril rim (**a**, **b**), or close to the nostril rim (**c**–**f**), despite all three cases being diagnosed as alar malposition

The orientation ranges from 30° to 65°, with a mean of approximately 45°. Some surgeons prefer to use the midpoint of the lateral crus rather than the caudal border (Fig. 2.52d) (Toriumi and Asher 2015). A third cause for alar malposition can be the *shape* of the lateral crus (a bit more complex to understand). A convex-concave lateral crus in the transverse axis (parenthesis tips) can simulate alar malposition. It is probable that the "parenthesis" that Sheen saw was the junction between a convex medial and concave lateral crus rather than the caudal border of the lateral crus. Currently, alar transposition for treating cephalic orientation is almost a reflex response, but it is becoming less necessary as newer, simpler techniques are developed (Çakır 2016; Davis 2015).

LATERAL CRUS: LATERAL CRURAL CONVEXITY SUTURE

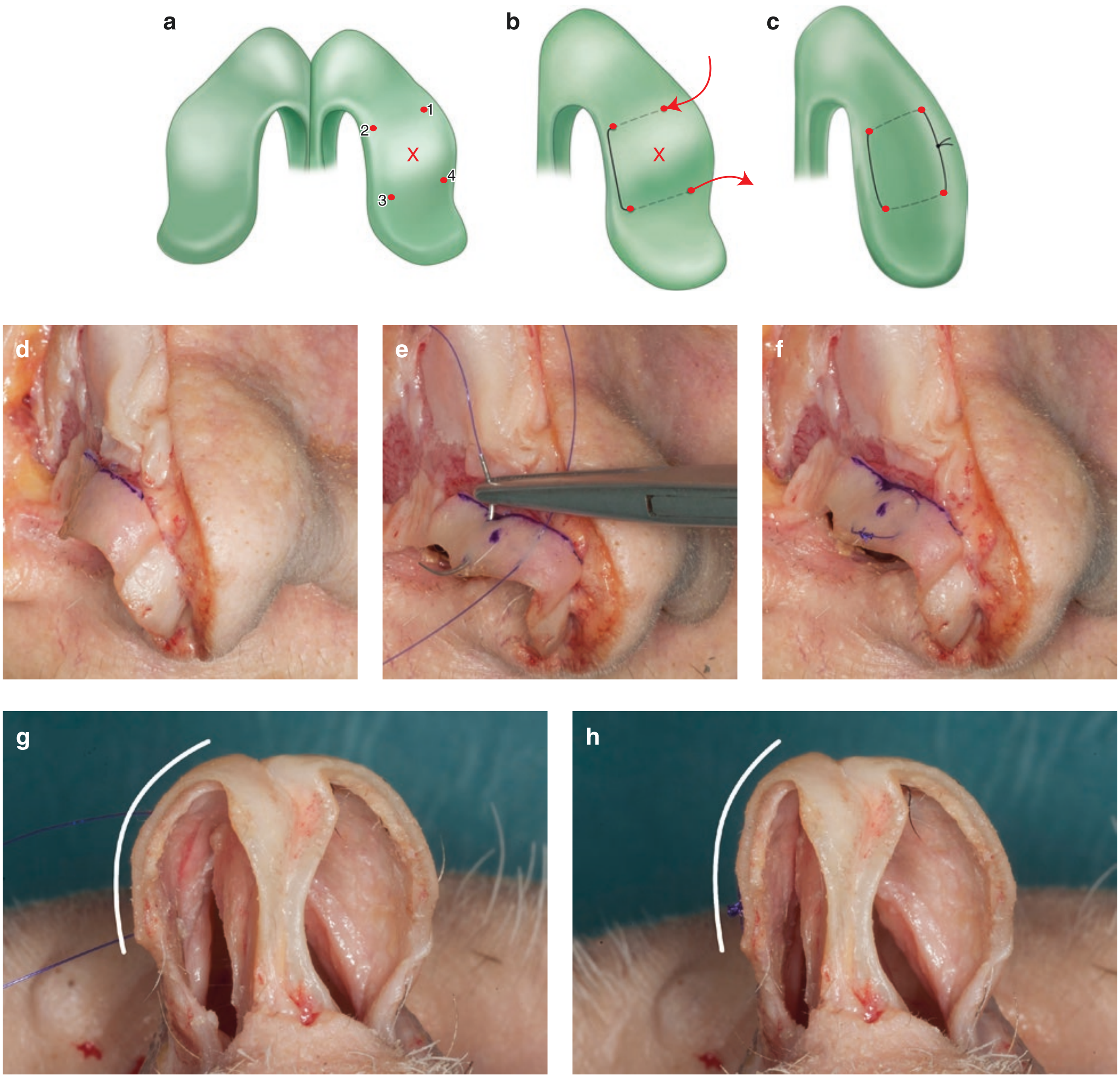


Fig. 2.53 (**a–f**) Lateral crural convexity suture (LCCS). (**g**, **h**) Effect of lateral crural convexity suture alone

The **lateral crural convexity mattress suture (LCCS)** was pioneered by Gruber et al. (2005) and has revolutionized our treatment of the wide tip, as well as broad, boxy, and ball tips. It is a simple, transverse mattress suture that is placed at the point of maximum convexity on the lateral crus (Fig. 2.53). It eliminates convexity in the alar rim strip without incising or excising the alar cartilage. Previously, the only solution was some variation of interdigitating cuts or segmental excisions, which ultimately led to bossa formation or lateral crura collapse. The LCCS must be mastered. The point of convexity is marked with a pen, and then a mattress suture straddles it perpendicular to the rim strip beginning from the caudal border. The needle enters about 1 mm from the caudal edge and exits 1 mm from the cephalic edge; then a similar bite is taken 6–8 mm laterally, coming from the cephalic to the caudal border. The suture is gradually tightened until the convexity is flattened. Key points to remember are that the suture must always begin from the *caudal border*, and it is tightened only until the rim strip is *straight*, not concave. It is also important not to try to do too much with one suture: multiple LCCSs can be added in a chain configuration.

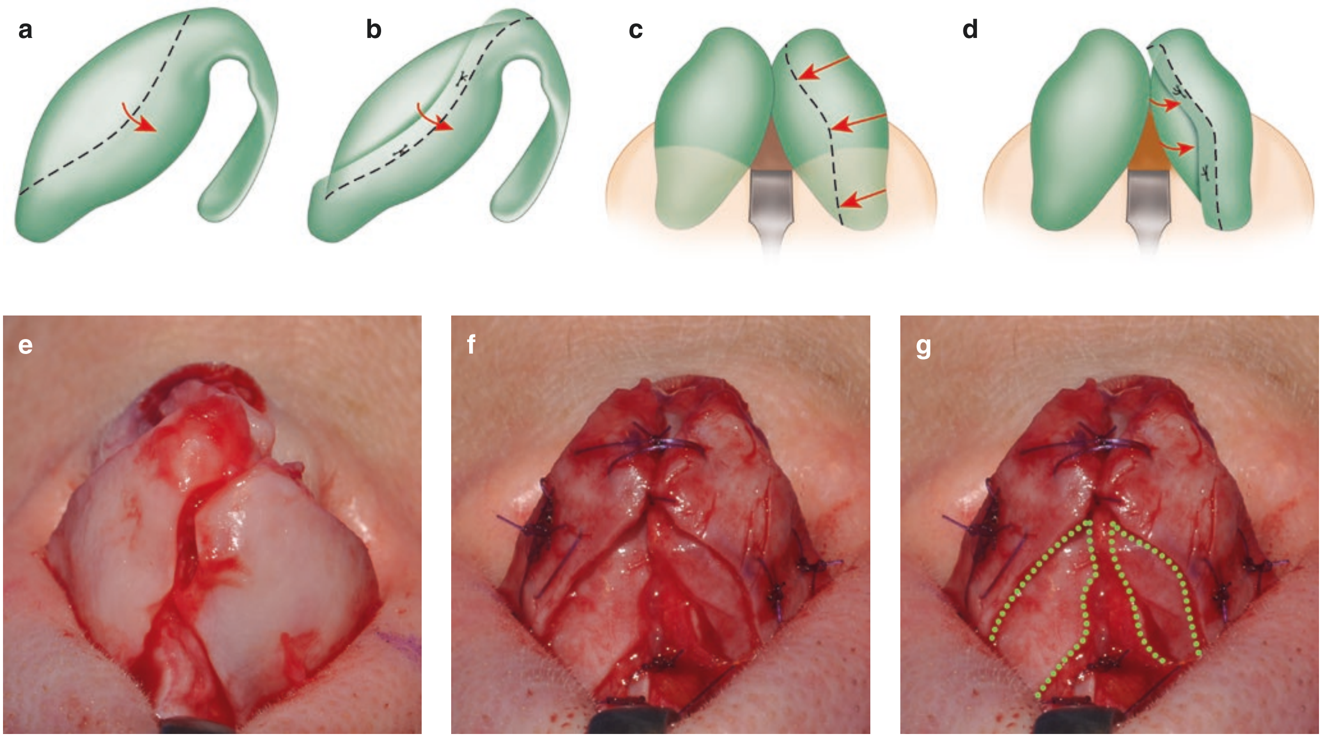


Fig. 2.54 (**a–g**) Preservation of the cephalic lateral crus

Gruber et al. (2010) popularized the concept of preserving an "island" of cephalic lateral crus to prevent alar retraction (Fig. 2.54). His technique consisted of the following steps:

1. An open approach
2. An intercartilaginous incision
3. A transcartilaginous incision through the lateral crus 6 mm back from the caudal border
4. Correction of any bulbosity with an LCCS
5. Sliding the *island* of cephalic lateral crus *under* the rim strip
6. Trimming of any distorting irregularities at the cephalic border
7. Fixation of the two segments with two sutures of 5-0 PDS

Ozmen et al. (2009) described a similar technique of simply *sliding* the intact cephalic portion of the lateral crus under, without creation of an island. This method ensures preservation of the scroll ligament and the attachment between the lower lateral cartilage and upper lateral cartilage. Based on our personal experience with 25 cases, we found some degree of fullness and excessive volume in three Middle Eastern patients at 1 year postop. Patient selection is perhaps important, but the idea of preserving as much lateral crura as possible is easily justified.

LATERAL CRUS: LATERAL CRURAL CONVEXITY SUTURE (CASE STUDY)

Analysis: A 50-year-old woman presented with a complaint that her nose was too big, especially the round, bulbous tip. Her tip/lobule measured 22 mm in width. There was no alar malposition. The skin sleeve was thick (Fig. 2.55).

Operative Technique:

1. Open approach with septal exposure through a unilateral right transfixion incision
2. Minimal dorsal reduction (B < 1.0, C 1.0); septal harvest
3. Bilateral spreader grafts
4. Excision of cephalic lateral crus
5. Tip sutures: CS, DC, ID, DE, TP, LCCS ×2
6. Fascia graft to radix and dorsum

Commentary: The lateral crural convexity suture (LCCS) is extremely effective in eliminating convexities in the symmetrical rim strip (Fig. 2.56). As the cartilage becomes more rigid, additional LCCSs are added, and one forms a "chain" of sutures until the desired shape is achieved. The biggest advantage of the LCCS is its precision in correcting the convexity. It also minimizes any retracting of the alar cartilage from the alar rim, which is common with Tebbett's lateral crural spanning suture.

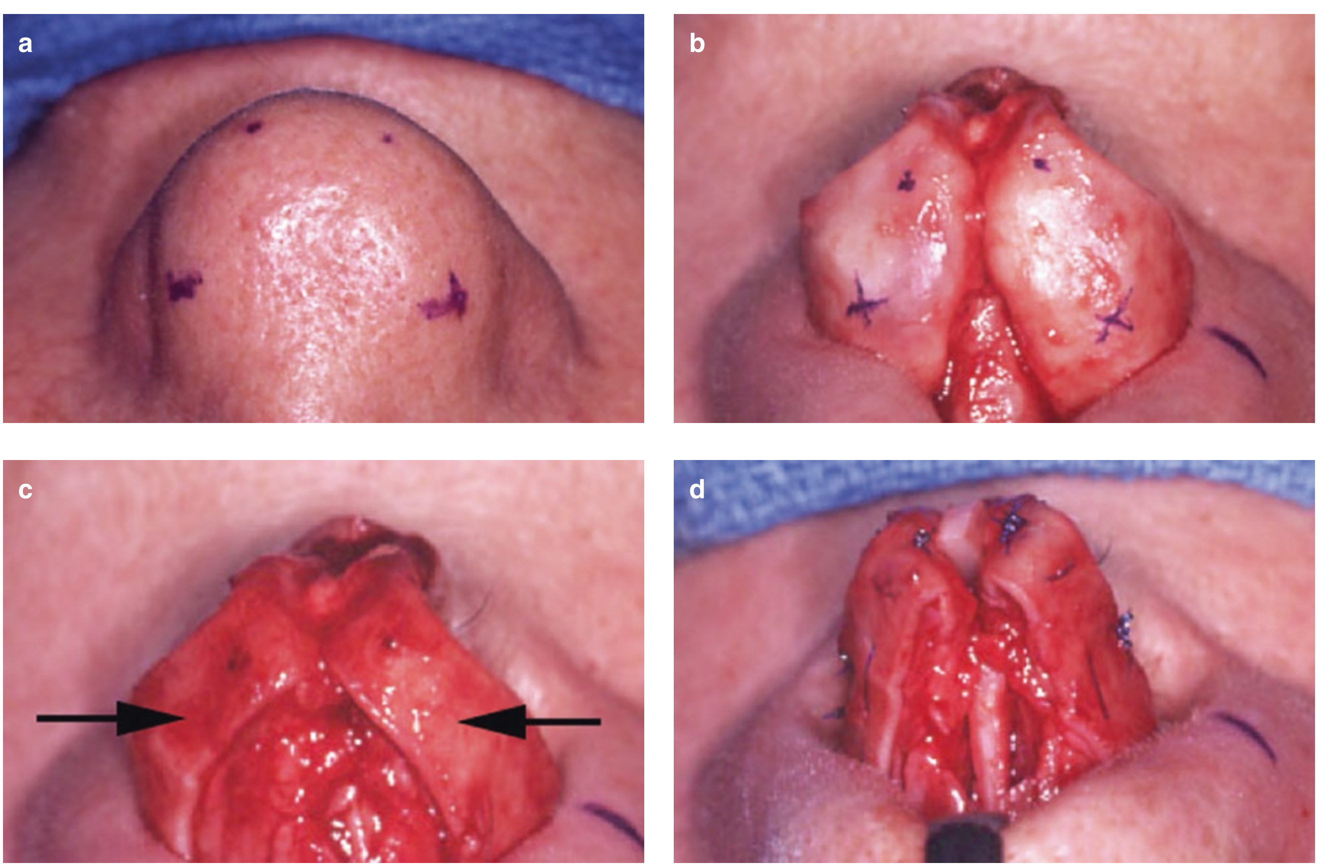


Fig. 2.55 (**a–d**) Lateral crural convexity suture

LATERAL CRUS: LATERAL CRURAL CONVEXITY SUTURE (CASE STUDY)

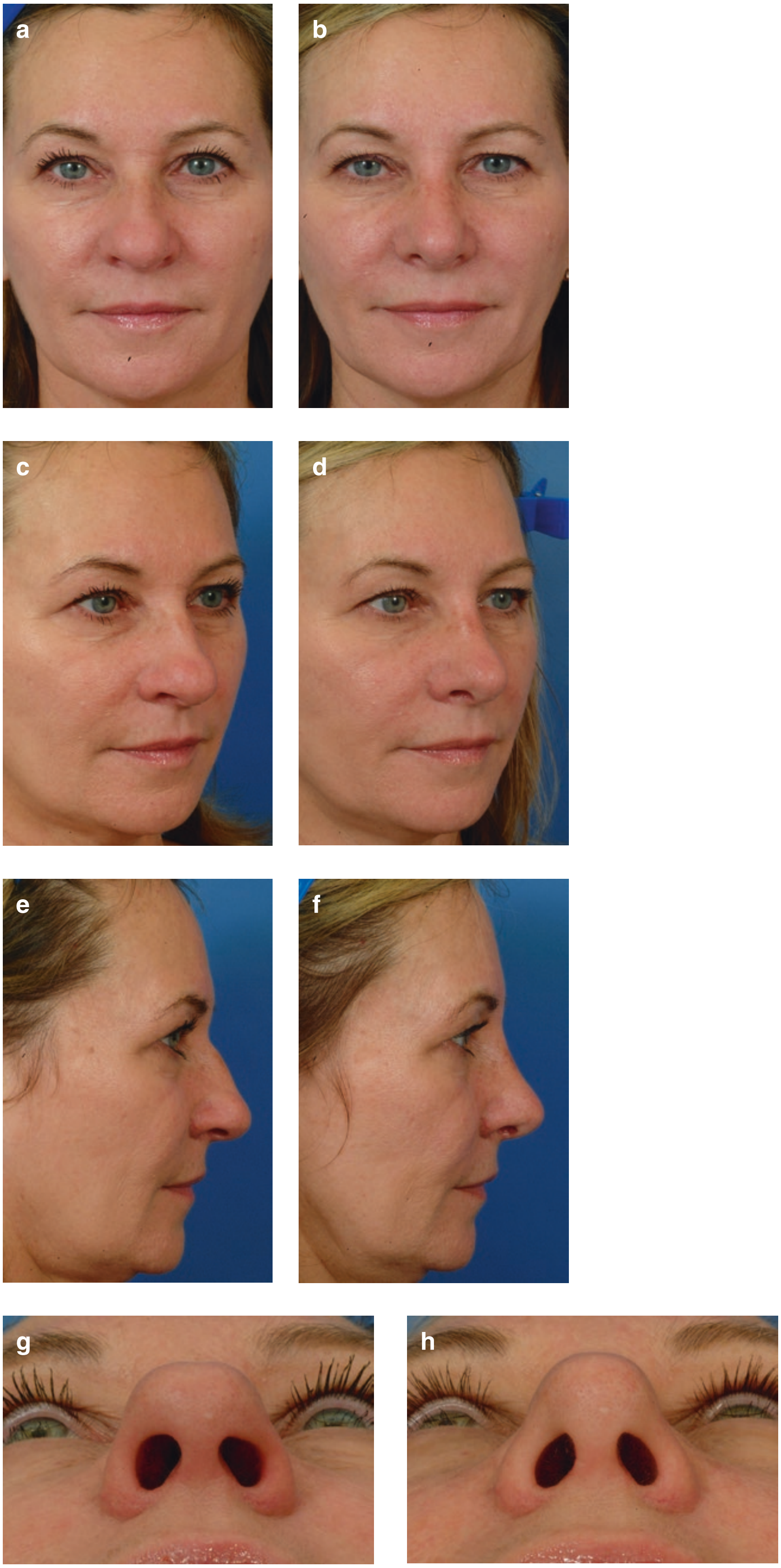


Fig. 2.56 (**a–h**) Patient before (*left*) and after (*right*) correction of tip bulbosity using lateral crural convexity sutures

LATERAL CRUS: LATERAL CRURAL STRUT GRAFTS

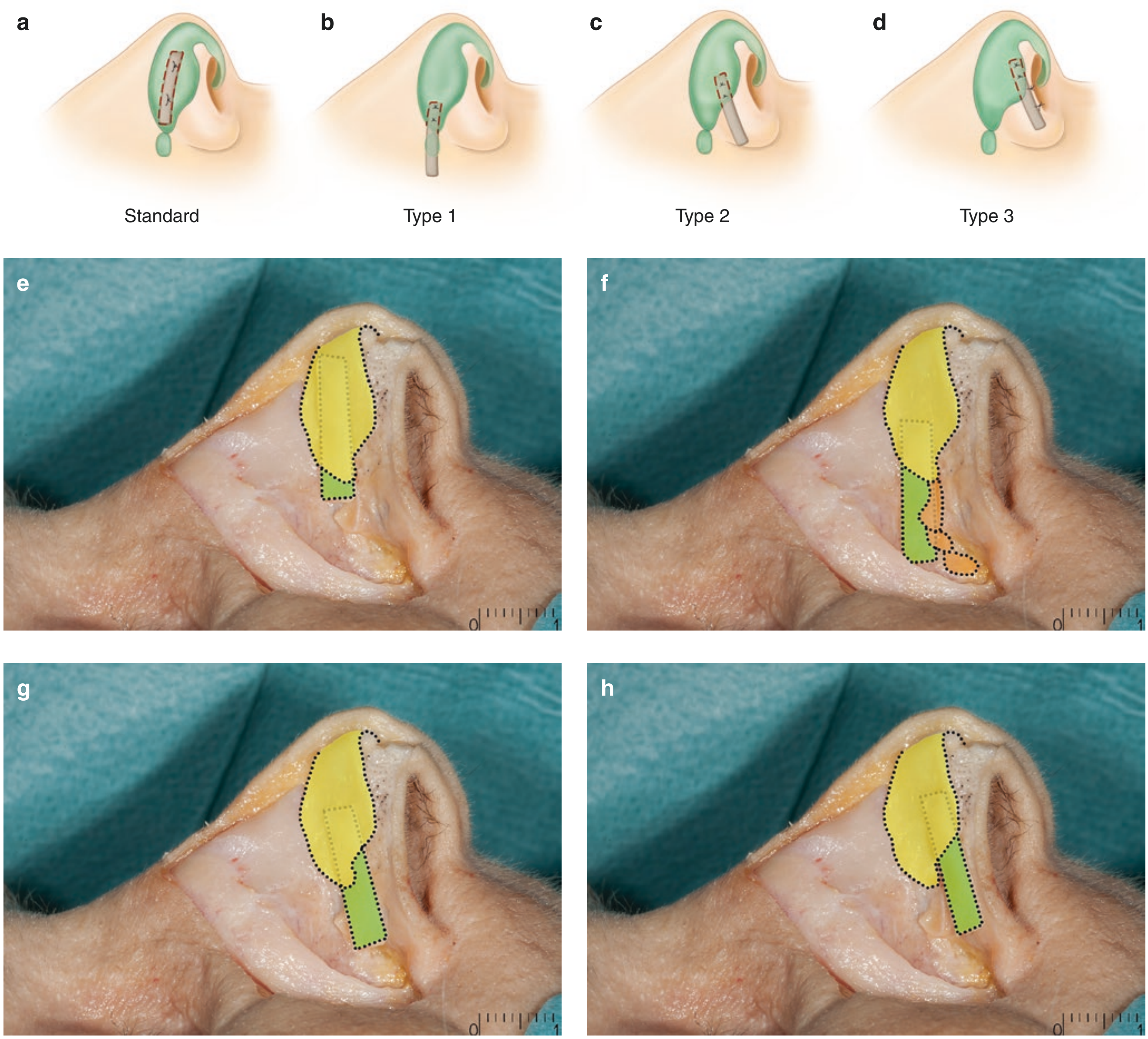


Fig. 2.57 Lateral crural strut grafts (*green*) consists of the following: (**a**, **e**) standard and extended types including (**b**, **f**) Type I, (**c**, **g**) Type II, and (**d**, **h**) Type III

Lateral crural strut grafts (LCSGs) were developed by Gunter and Friedman (1997) to reshape, reposition, or reconstruct the lateral crus. Essentially, they are straight, strong pieces of cartilage measuring 3–4 mm in width by 14–20 mm in length. When only reshaping of the lateral crura is required, a standard LCSG can be used (Fig. 2.57a, e); this is a *shaping* graft to eliminate convolutions within the lateral crus. The medial portion of the graft is sutured to the *undersurface* of the alar cartilage, and the distal end is placed in a lateral pocket. The desired pocket is dissected in one of three positions: underneath the accessory cartilages (Type I, Fig. 2.57b, f); extending into the alar base (Type II, Fig. 2.57c, g); or along the nostril rim (Type III, Fig. 2.57d, h). These grafts are highly tapered, being thin at the cephalic end to avoid distorting the domal area, but thicker laterally.

LATERAL CRUS: LATERAL CRURAL STRUT GRAFTS WITH ALAR TRANSPOSITION (FIG. 2.58)

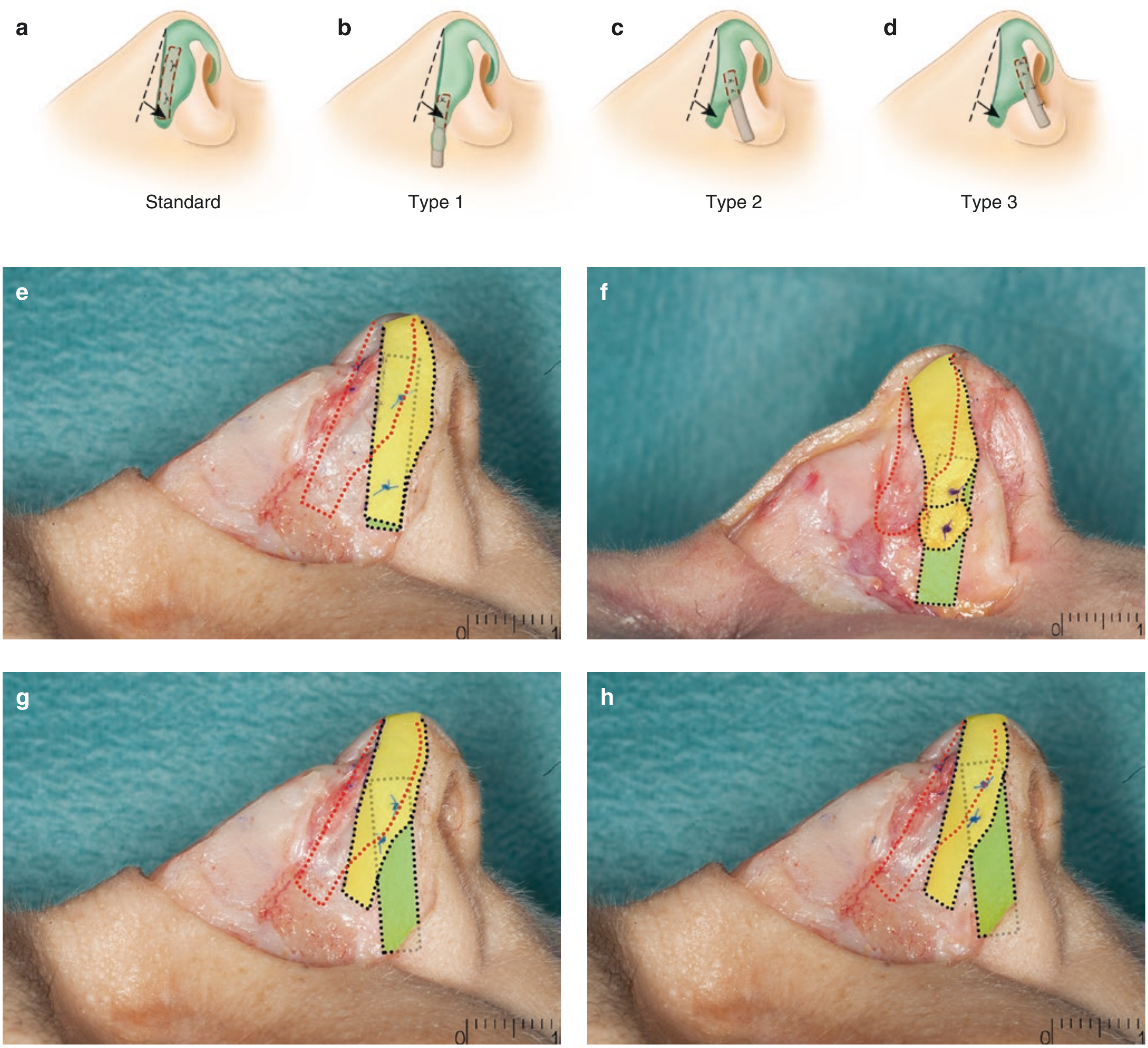


Fig. 2.58 (**a–h**) *Alar transposition* with standard and extended lateral crural strut grafts (*green*). Red dotted area denotes original location of lateral crus while yellow area indicates transposed lateral crus

Lateral crural strut grafts are virtually always used when alar transposition is done, to avoid subsequent collapse. Based on clinical experience, a completely mobilized lateral crus is far weaker than in its nonmobilized state, and collapse into the vestibule is inevitable unless support is added - no matter how good it might look intraoperatively. Cases with alar transposition, in which a fundamental change is tip shape is desired, are very complex. Alar transposition implies dividing the lateral crura at the junction with the A1 accessory cartilage, undermining the entire lateral cartilage up to the domal segment, and then transposing it from a cephalic position to a more caudal position paralleling the nostril rim. In these cases, we have found it important to completely release the lateral crus and attach the LCSG *prior* to commencing the tip surgery. Once the alars are transposed and the LCSG is sutured to the lateral crus, then the surgical sequence is as follows: (1) columellar strut, (2) tip suturing with optional TRG grafts, and (3) placing the LCSG, most commonly into an alar base pocket (Type II). In certain cases, additional alar rim grafts or even alar rim structure grafts are required.

LATERAL CRUS: LATERAL CRURAL STRUT GRAFTS (CASE STUDY)

Analysis: A 50-year-old man presented complaining of severe bilateral nasal obstruction unresponsive to medical therapy. Internal examination revealed septal body deviation to the left, caudal septal deviation to the right, and bilateral internal valve collapse. In addition, there was marked asymmetry of the bony vault. The patient asked if the nose could be made smaller and the tip less dependent at the same time.

Operative Steps:

1. Open approach followed by septal exposure
2. Congenital vascular "lacunae" in the alar cartilages found on tip evaluation (Fig. 2.59a, c)
3. Incremental dorsal reduction (bone 1.0 mm, cartilage 3.5 mm)
4. Septoplasty with excision of 12-mm spur, relocation of caudal septum R to L
5. Osteotomies: medial oblique bilaterally, double level R, low-to-low L
6. Release and reposition of the lateral crura, with addition of lateral crural strut grafts (Fig. 2.59b, d)

Commentary: The transverse convexity of the cartilages disappeared only after the alar cartilages were completely elevated off the underlying mucosa. Mucosa can act as a restraining force on the alar cartilages, controlling their shape. The lateral crura were reduced to a 7-mm rim strip, and then lateral crural strut grafts were sutured to their undersurface. The alar cartilages were transposed into the Type II position, with the strut going into the alar base. As shown at 1 year postop (Fig. 2.60), the tip appears quite natural and in balance with the patient's stature.

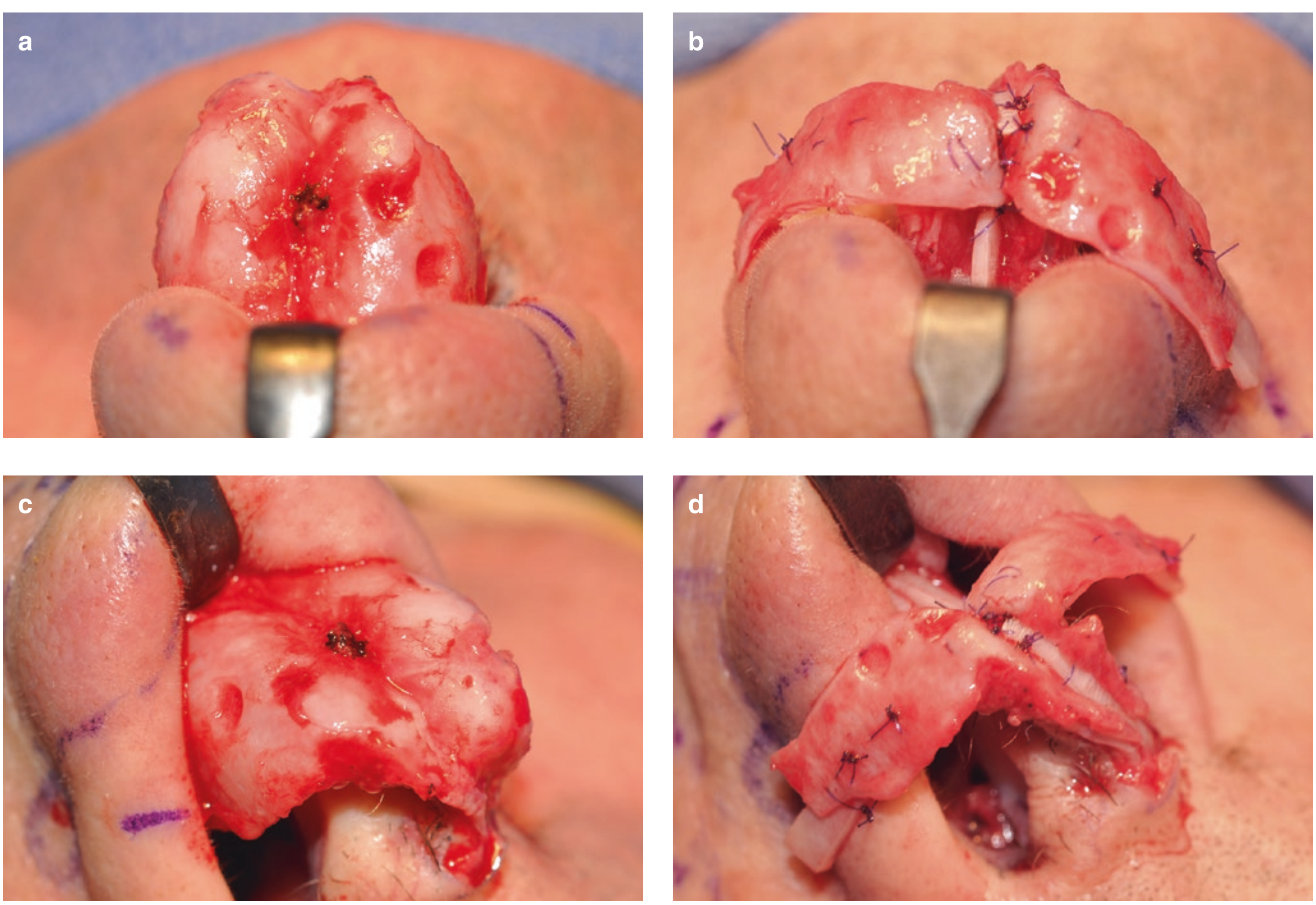


Fig. 2.59 (**a–d**) Alar transposition plus Type II extended lateral crural strut graft

LATERAL CRUS: LATERAL CRURAL STRUT GRAFTS (CASE STUDY)

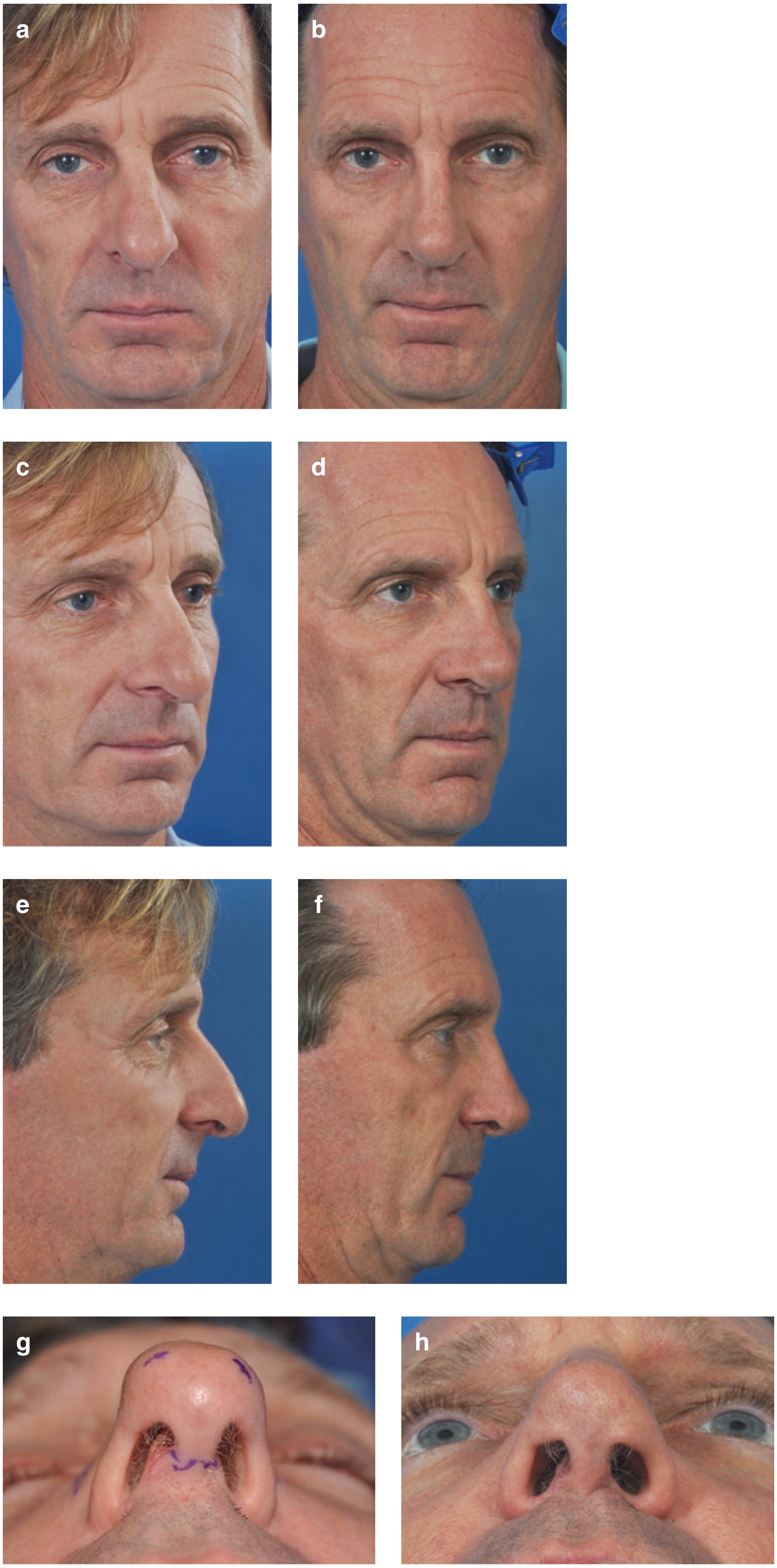


Fig. 2.60 (**a–h**) Case study patient before surgery (*left*) and 1 year after correction using lateral crural strut grafts (*right*)

LATERAL CRUS: TURN-UNDER FLAP

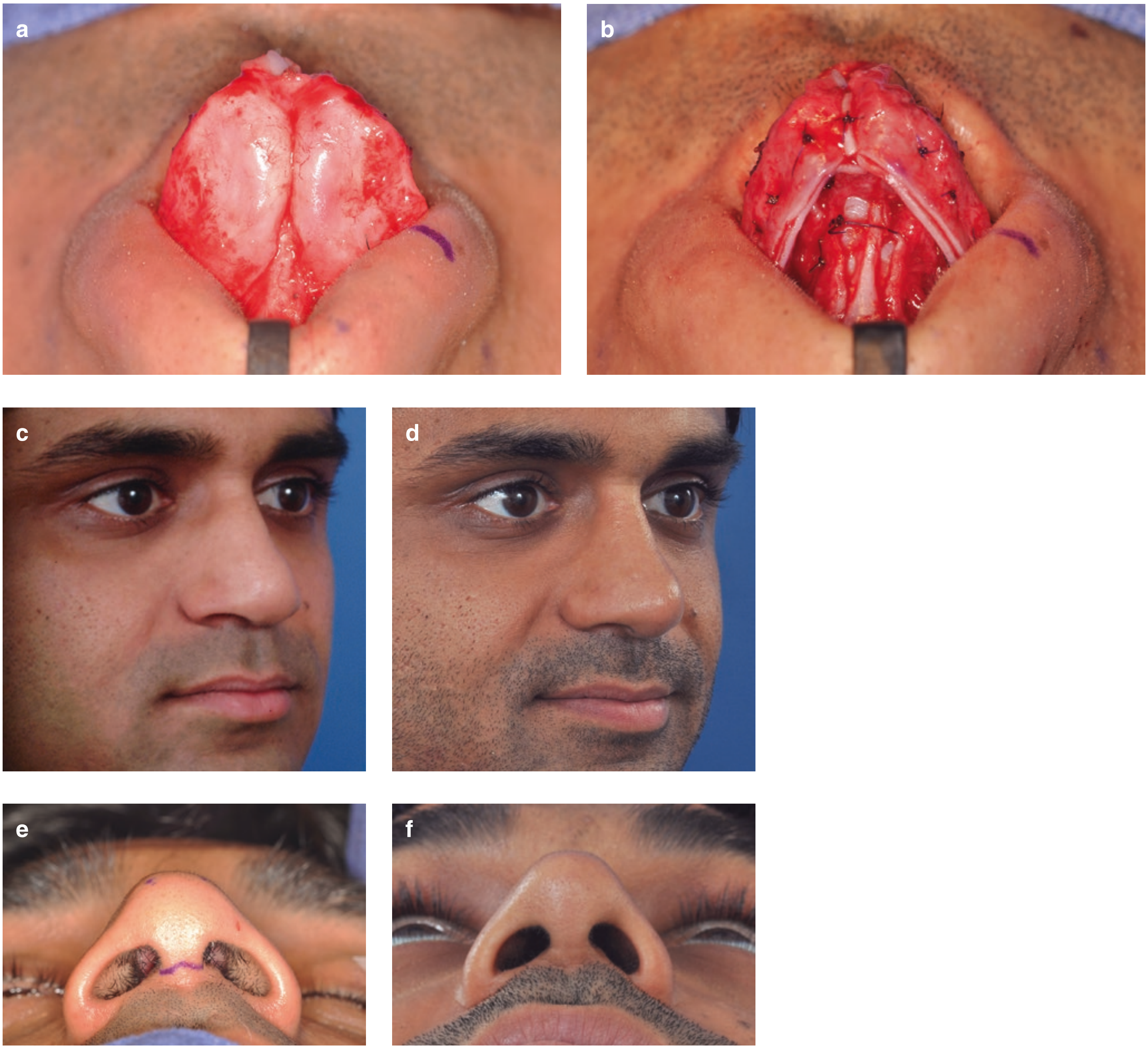


Fig. 2.61 (**a**, **b**) Turn-under flap procedure intraoperatively. (**c–f**) Preoperative (*left*) and postoperative (*right*) photos

The steps in the actual execution of a turn-under flap (Fig. 2.61) are relatively straightforward: First, dissect the lateral crus off the underlying mucosa, beginning at the scroll junction, and continue downward almost to the caudal border. Next, incise the lateral crus at its transverse midline, beginning near the dome, and continue laterally while preserving a complete rim strip. It is important to maintain a "lateral hinge" to give some rigidity to the turned-under cartilage. If it is completely divided, the cartilage becomes a "graft" with little structural integrity. Once incised, the cephalic cartilage is turned under the intact caudal rim strip and fixed with #30 needles. The sandwiched cartilages are then sutured together with 5-0 PDS sutures.

As this procedure is done to provide support for weak concave lateral crura, why not use it routinely, as some surgeons do? The simple answer is that unless the lateral crus is concave to begin with, the turn-under flap will raise the cephalic border of the rim strip above the caudal border, resulting in an unattractive fullness of the tip lobule. Surgeons then must add a lateral crural spanning suture (LCSS) to push down the new cephalic border, so the turn-under flap procedure should be used only when indicated.

LATERAL CRUS: TURN-OVER FLAP

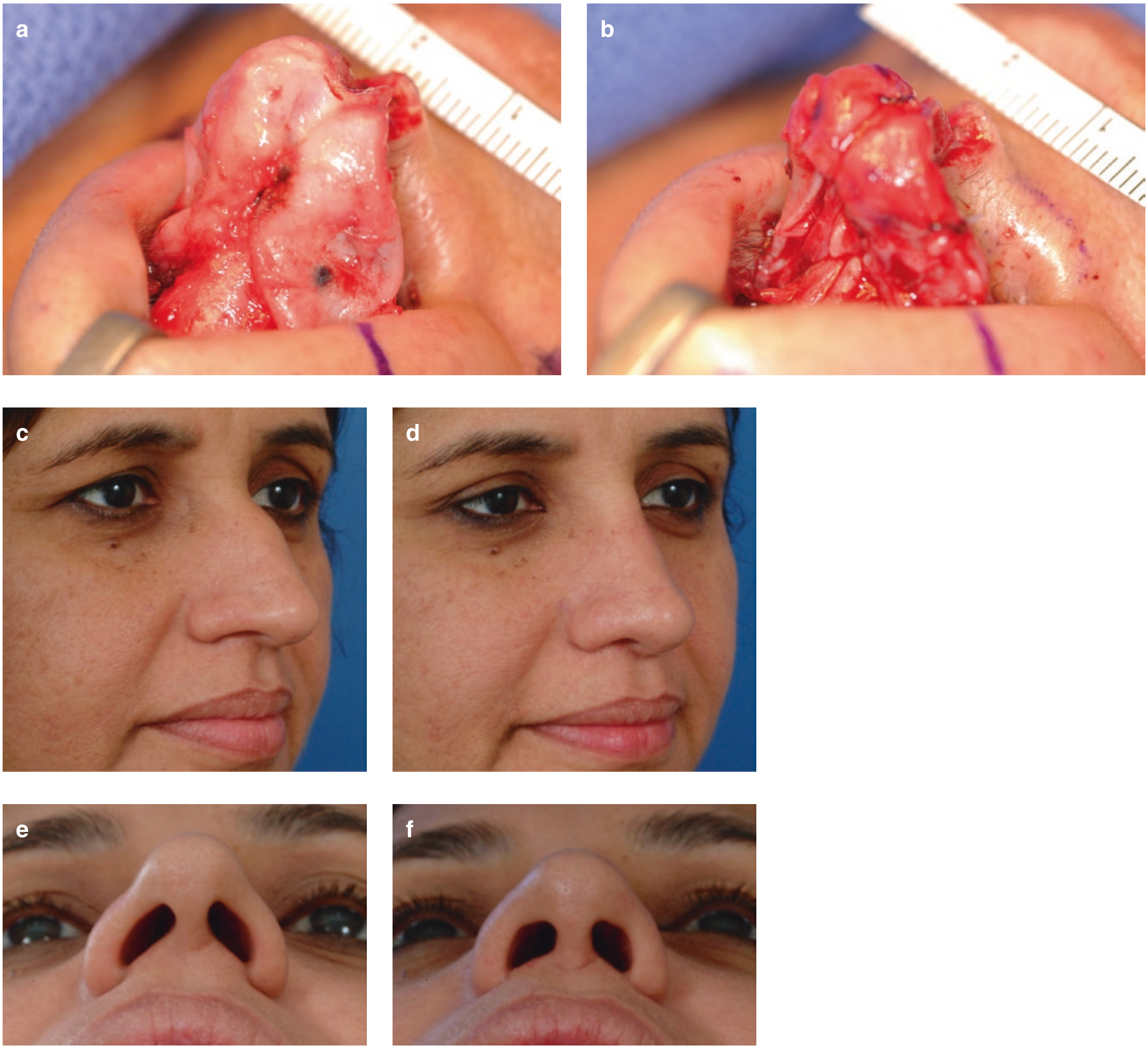


Fig. 2.62 (**a**, **b**) Turn-over flap procedure intraoperatively. (**c–f**) Preoperative (*left*) and postoperative (*right*) photos

The turn-over flap (Fig. 2.62) began initially as a simple onlay graft from excised cephalic lateral crura during closed-tip delivery rhinoplasty (McCollough and Fedok 1993). With adoption of the open approach, it became obvious that the lateral crus could either be used as a graft or simply turned over to fill the concavity. In most cases where 10 mm or more of lateral crus is present with a significant concavity, then a turn-over flap is done. First, the transverse midline is marked and the cephalic lateral crus is undermined from the vestibular lining. Then the cartilage is incised full-thickness at either end, with careful tapering into the domal segment and a partial incision centrally. Then the cephalic segment is folded over and sutured along the caudal border with interrupted sutures of 5-0 PDS. Often, the flap is shifted toward the dome to ensure a smooth transition between flap and dome. Gunter and colleagues prefer a variation where the central partial cut is made on the undersurface of the lateral crus and then hinged over (Janis et al. 2009). The goal is to give greater support to the external valve. In general, we see the turn-over flap as an aesthetic maneuver and use the turn-under flap for structural support.

LATERAL CRUS: COMBINATION OF THE TURN-UNDER AND TURN-OVER FLAP

Fig. 2.63 (**a**, **b**) Intraoperative photos showing a combined turn-under flap and turn-over graft on the right side. Inital turn-under flap was inadequate and thus excised cepahlic lateral crus from the left side was added. (**c–f**) Preoperative photos (*left*) and postoperative photos (*right*) at 1 year

Excised cephalic lateral crus can be used as a graft to correct minor concavities of the lateral crus. Usually, the key step is to tailor the cartilage at the domal junction to get a smooth transition. Interrupted sutures of 5-0 PDS along the caudal and cephalic borders are sufficient. In the case shown in Fig. 2.63, a turn-under flap was done first on the right side to give functional support to the concave lateral crus, but it was not sufficient to correct the aesthetic depression, so an add-on graft was done using excised cephalic cartilage from the opposite left lateral crus. An alternative would have been simply to do a lateral crural strut graft under the mobilized lateral crus. Septal cartilage was at a premium in this case, however, so an “under/over” flap/graft of lateral crus was done.

LATERAL CRUS: FLIP-OVER FLAP

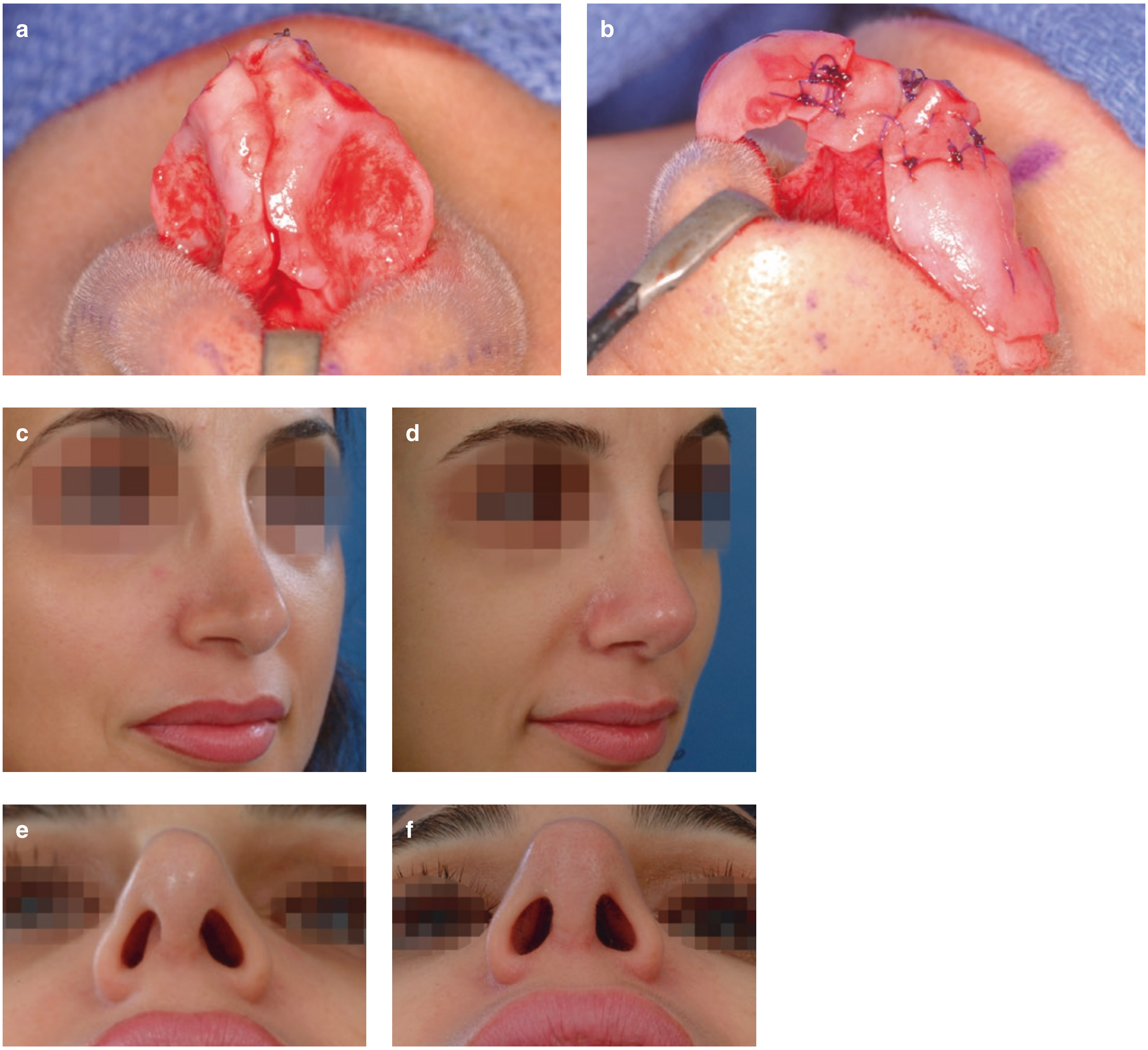


Fig. 2.64 (**a**, **b**) Flip-over flap intraoperatively. (**c**–**f**) Preoperative photos (*left*) and postoperative photos (*right*) at 1 year

Excision and rotation (flip) of a severely concave lateral crus is a long-established technique (Tardy and Brown 1990). Four variations are possible: (1) Complete medial and lateral cuts with 180° rotation; (2) Same excision, but transfer between the two sides: L to R and R to L; (3) Insertion of a lateral crural strut graft, followed by rotation; (4) Maintenance of an intact 2–3-mm caudal rim strip, then excision of the concave cephalic lateral crus, followed by rotation. The medial incision is made just lateral to the domal prominence, and the lateral cut is made near the junction with the accessory cartilage. If there is marked vestibular collapse, then insertion of a long lateral crural strut graft should be considered. If the lateral crus concavity is only moderately collapsed, then a caudal cuff can be maintained, which makes the procedure technically easier. In Fig. 2.64, note the dramatic postoperative correction of the preoperative vestibular collapse on the basilar view, plus clinical improvement in the lateral depression.

TIP SURGERY: THE THREE-CRUS CONCEPT (CASE STUDY)

A 25-year-old man of Hispanic descent requested a rhinoplasty. He wanted a significant change to eliminate the hanging tip and wide, visible nostrils. The key to analysis is the *three-crus concept*. Anatomically the alar cartilages are normal, but they are rotated downward to create a *snarl tip*. The most startling aspect of the deformity is the apex of the nostril rim above the tip angle on lateral view (Fig. 2.65). As will be seen, no excision or incision of the alar cartilages is needed; instead, each of the three crura are rearranged and repositioned to their aesthetic ideal.

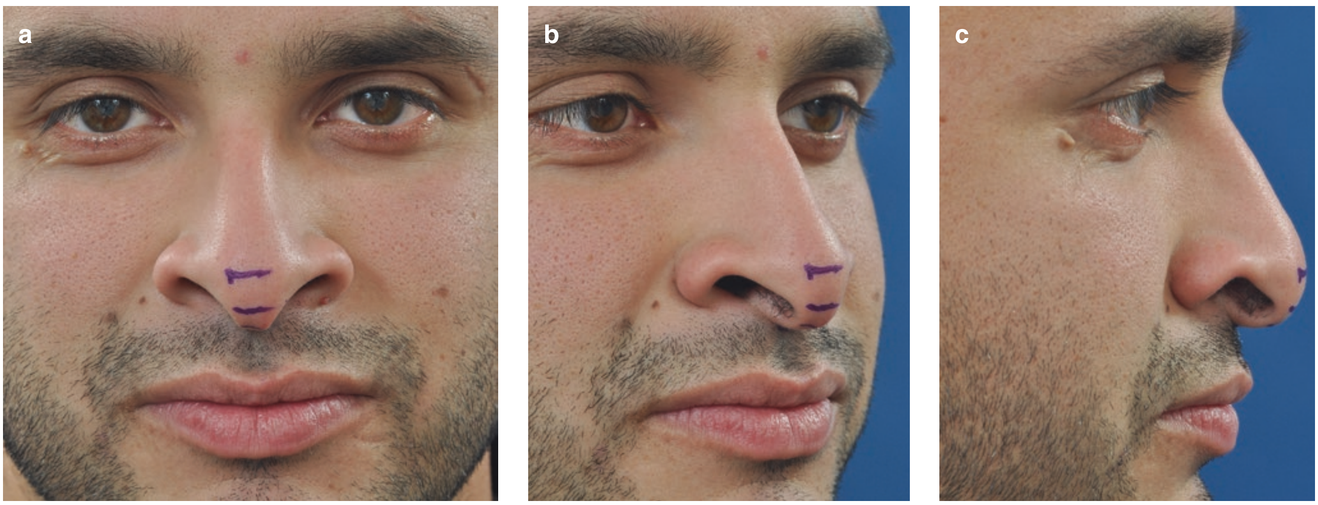


Fig. 2.65 (**a–c**) Patient with a snarl tip

Step #1. Tip analysis (Fig. 2.66). Transfer of the surface aesthetics to the underlying anatomy reveals that the c′ is 3 mm below the nostril apex. The columellar inclination is 80°. The operation would be to verticalize the footplates and advance the columellar segment of the medial crus upward.

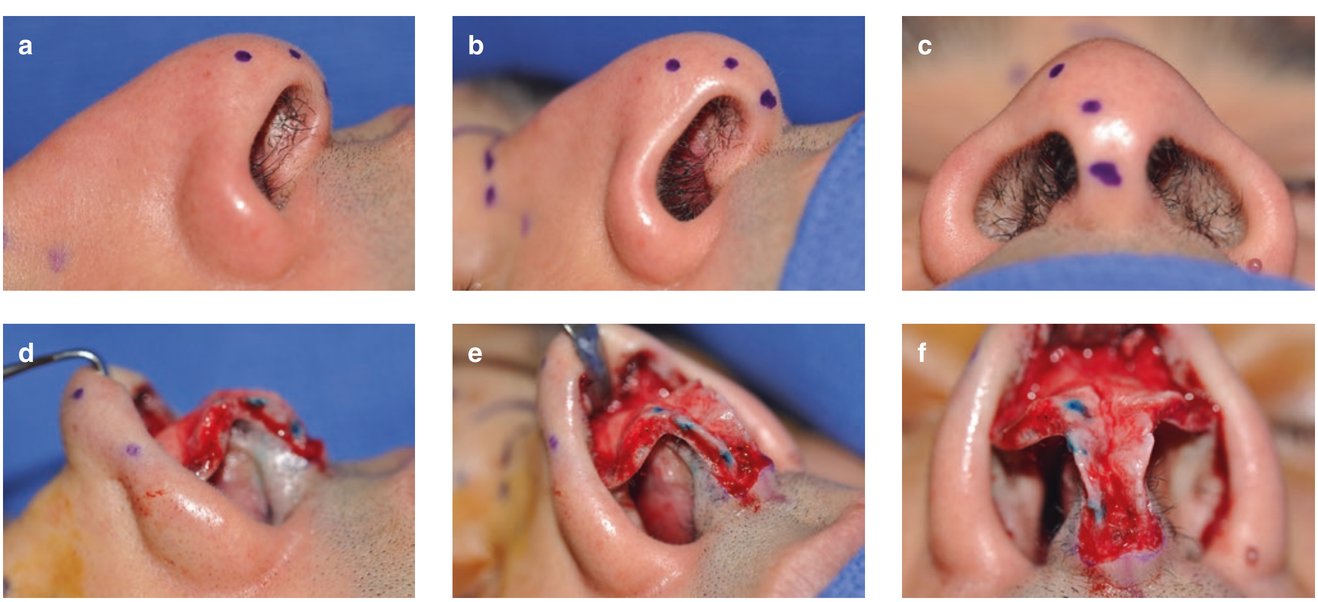


Fig. 2.66 (**a–f**) Transference of surface aesthetics to underlying alar anatomy

Step #2. Medial crus (Fig. 2.67a–c). A modified TIG was done to raise the footplates onto the caudal septum and to correct the columellar inclination. In addition, c′ was elevated to the ASA to correlate with the top of the nostril.

Step #3. Middle crus. Domal creation (Fig. 2.67d–f). Simple cephalic dome sutures (CDS) were inserted at the *anatomical domes*. This was *not* a lateral steal, as it correlated with the natural junction between the domal notch and lateral crus.

Step #4. Septo-columellar graft (Fig. 2.67g–i). A 30-mm × 8-mm septo-columellar graft is sutured to the caudal septum and the medial crus. This is not a septal extension graft This is not a septal extension graft as the septum was not lengthen.

Step # 5. Lateral crus tensioning (Fig. 2.67j–l). Sutures were placed from the domal segment to the septo-columellar graft.

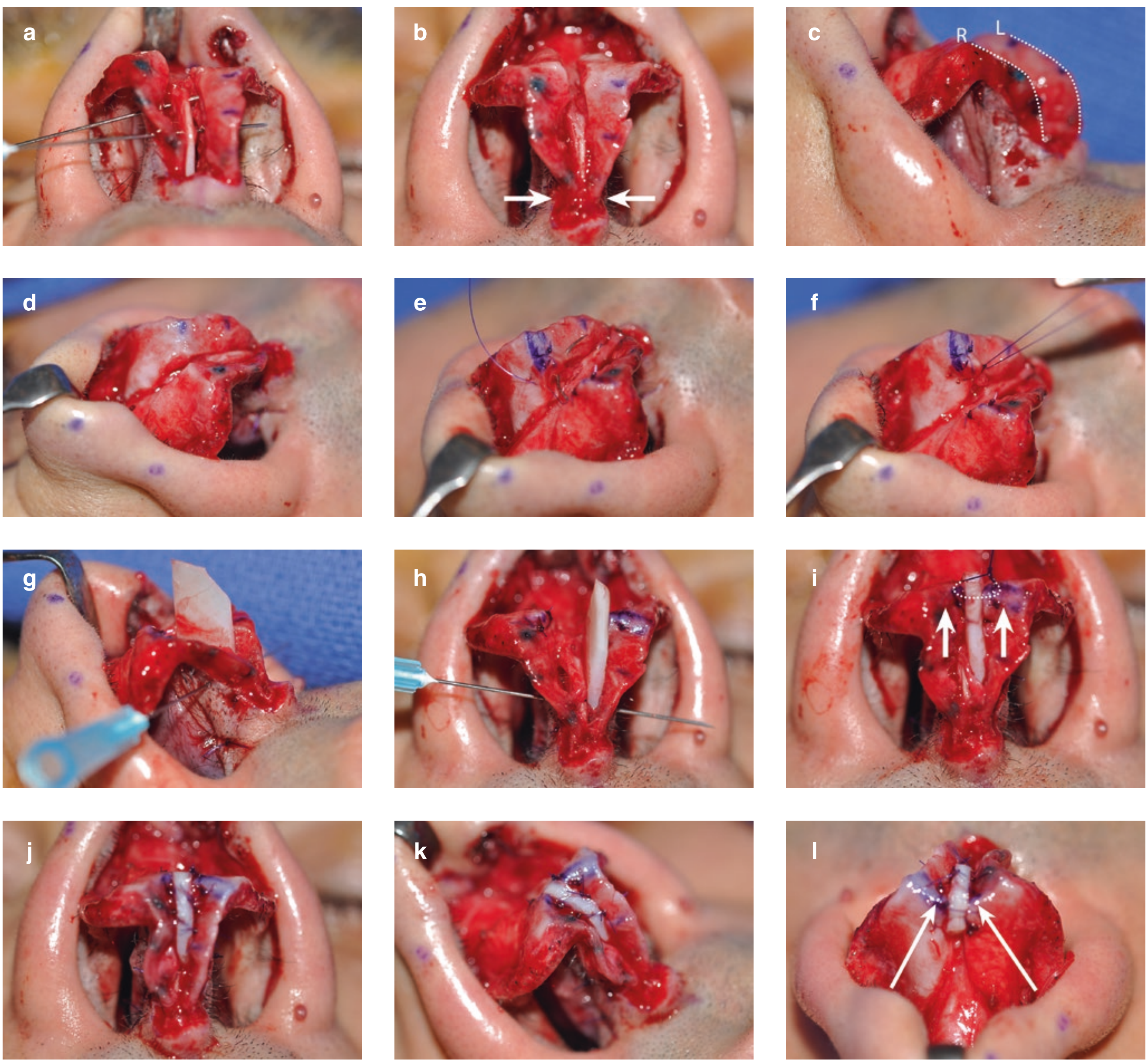


Fig. 2.67 (**a–c**) Modified tongue-in-groove to elevate columellar inclination and raise location of c′. (**d–f**) Creation of tip definition with a simple cephalic dome suture. (**G–i**) Septocolumellar graft with elevaton of alar cartialges to create greater intrinsic tip projection. (**j–l**) Lateral crural tensioning achieved by suturing the middle crus to the septocolumellar graft

TIP SURGERY: THE THREE-CRUS CONCEPT (CASE STUDY)

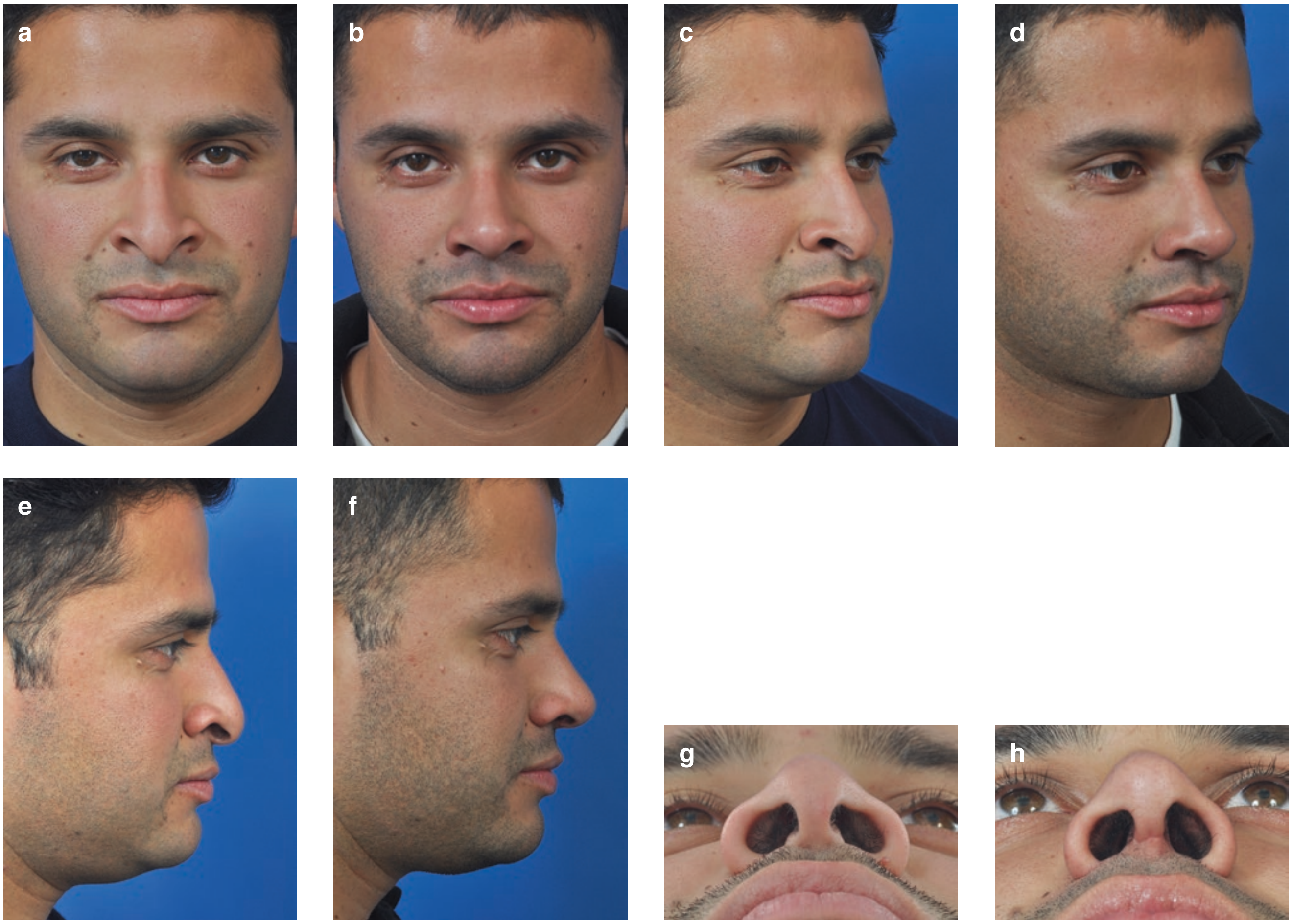


Fig. 2.68 (**a–h**) Preoperative photos (*left*) and postoperative photos (*right*)

Commentary: This case illustrates the importance of conceptualizing the alar cartilages as three crura, each divided into two segments with two junction points. Conceptually, the tip deformity was conceived of as a downward rotation of the alar cartilages rather than an abnormal anatomy. Each point was corrected without any recourse to excision or incision of the alar cartilages. Equally, the dramatic change in the nose was achieved without any dorsal reduction or osteotomies (Fig. 2.68). The first step was to change the columellar inclination from 80° to 95°. After a 2.5-mm excision at the caudal point of the caudal septum (no ASA excision), a modified tongue-in-groove procedure was done, which upwardly rotated the footplate segment onto the shortened caudal septum. Next, a second suture lengthened the columellar segment of the medial crus and set the c′ breakpoint near the ASA and the top of the nostril. At this point, a simple cephalic dome suture was done at the almost ideal domal segment on the right. This maneuver was not a true lateral steal in the sense of recruiting new domal cartilage from the lateral crus. The septo-columellar strut was sutured in an appositional fashion to the caudal segment; it was not designed to lengthen the septum and thus was technically not a septal extension graft. Next, the lateral crus was sutured to the top of the septo-columellar graft, thereby achieving lateral crural tensioning (Davis 2015). This medialization also flattened the lateral crus–accessory cartilage junction and maintained the vestibular valve. At this point, a 3-mm nostril sill cinch procedure was done to reduce the nostril sill-width, followed by the insertion of alar rim grafts. Note: there is no abnormal anatomy, just abnormally located normal anatomy that needs to be repositioned.

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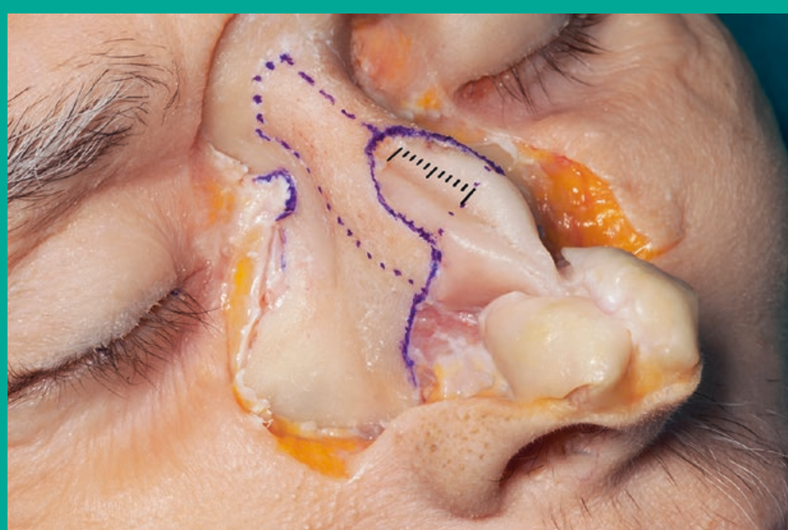
3 Osseocartilaginous Vault



For the vast majority of patients, their top three complaints in order of importance are a "bump" on profile, a lack of tip definition, and a wide nose. Two of these three problems are associated with the osseocartilaginous vault, especially when a "balanced approach" is employed. Anatomically and embryologically, the bony vault and cartilaginous vault are fused into a single entity—the osseocartilaginous vault (OC). During the past 5 years, major changes in surgical techniques have dramatically changed our approach to hump reduction, mid-vault reconstruction, and osteotomies. We strongly advocate rasping off the bony cap to expose the intact underlying cartilaginous vault. Next, the upper lateral cartilages (ULCs) are split off from the anterior septum and reserved for possible spreader flaps. Then, the dorsal profile is lowered by resection of the anterior dorsal septum using scissors. Many types of osteotomies are available, including lateral, medial, and intermediate. The recent introduction of piezoelectric instrumentation (PEI), with its extensive exposure and precise cuts, has led to greater precision in bony vault management. Once the bones have been mobilized, the surgeon must reconstruct the mid vault, using either spreader grafts or spreader flaps. When dorsal augmentation is required, it can be done using autogenous tissue with diced cartilage in fascia (DC-F), which is our preferred technique. Ultimately, the major advances in how we approach the dorsum have resulted in improved aesthetic and functional results.

OVERVIEW OF ANATOMY

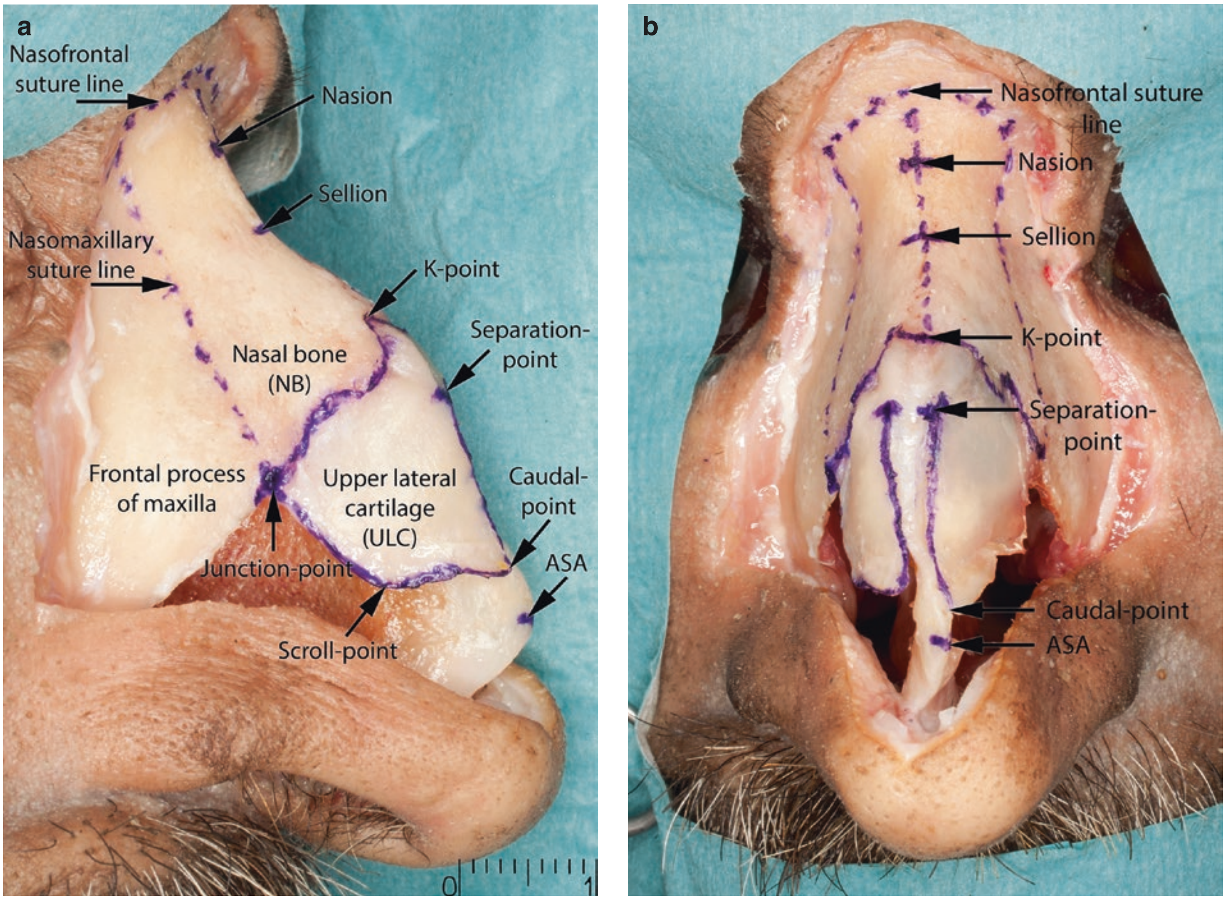


Fig. 3.1 (**a**, **b**) Overview of the bony vault and cartilaginous vault. *ASA* anterior septal angle

The OC consists of the frontal process of the maxilla, nasal bones, upper lateral cartilages (ULCs), and anterior septum. Following elevation of the soft tissue envelope, including the periosteum and perichondrium, the distinct landmarks of the OC are revealed (Fig. 3.1). They include the following in the bony vault:

- The *nasofrontal suture line*, which marks the junction of the fused nasal bones to the frontal bone
- The *nasomaxillary suture line*, which denotes the junction of the nasal bones with the maxilla
- The *nasion*, the deepest point on the bony radix
- The *sellion*, the deepest point in the soft tissue radix area.

Points can also be identified in the cartilaginous vault:

- The *keystone-point* (K-point)
- The *separation-point*, where the ULC separates from the dorsal septum, and only the perichondrium holds them together
- The *caudal-point*, the caudal end of the ULC along the dorsum
- The *junction-point*, the lateral edge of the ULCs along the pyriform aperture, which usually coincides with the nasomaxillary suture line
- The *scroll-point*, where the caudal and lateral edges of the ULC create an angle.
- There is a classic landmark on the cartilaginous septum: the *anterior septal angle* (ASA).

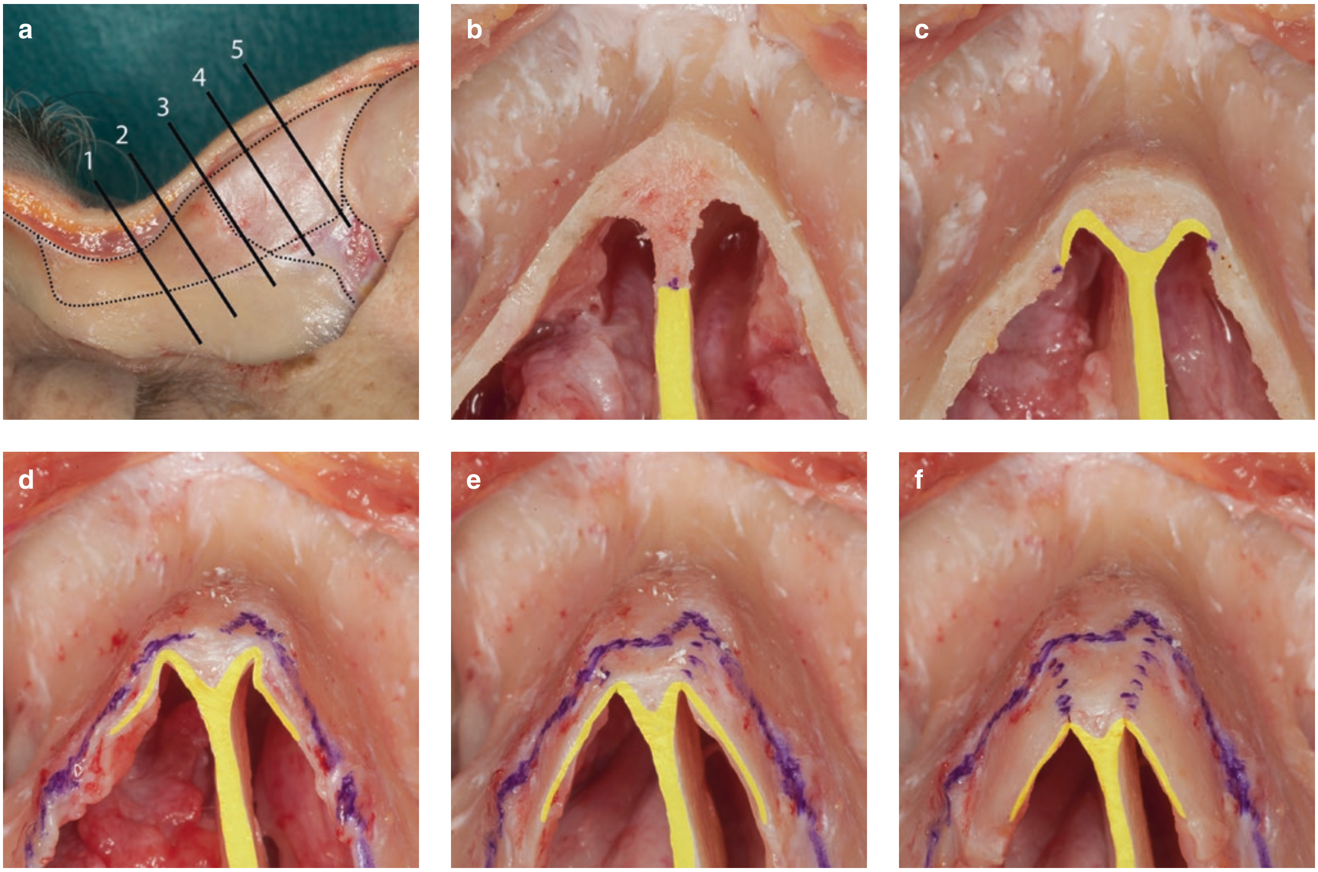


Fig. 3.2 (**a**) Cross-sections of the osseocartilaginous vault. (**b**) 1, (**c**) 2, (**d**) 3, (**e**) 4, (**f**) 5.

Understanding the anatomy of the OC is critical to the rhinoplasty surgeon for two reasons. First, its composition changes dramatically from cephalic to caudal. Second, surgical techniques are predicated upon an in-depth knowledge of the relationship between the bony vault and the cartilaginous vault. As shown in Fig. 3.2, one can see the progression from a dominant bony portion cephalically to its disappearance beyond the K-point, while the cartilaginous vault ends in the dynamic valve area near the ASA. The cut through the soft tissue nasion (Fig. 3.2b) emphasizes the solid fused bone in the radix area. At the midpoint between the nasion and the K-point (Fig. 3.2c), the overlap between the bone and underlying cartilaginous vault is obvious. Rather than designate this a "bony hump," it is more accurate to think of this as a "bony cap." Rather than remove it en bloc with an osteotome and create an open roof, it is much better to rasp off the bone, leaving an intact cartilaginous vault and no open roof. At the keystone junction (#3, Fig. 3.2d), the dorsum is now entirely cartilaginous, with a continuous progression from the septum into the ULCs. At the midpoint between the K-point and ASA (#4, Fig 3.2e), one begins to see a cleft developing in the cartilaginous vault, separating it into a dorsal septum and paired ULC. As one nears the ASA, the dorsal septum has progressed from "Y" to "V" to now relatively straight, while the ULCs have distinctly separated from the septum, allowing them to move at the internal valve angle (#5 Fig. 3.2f).

RADIX AND DORSAL AESTHETICS

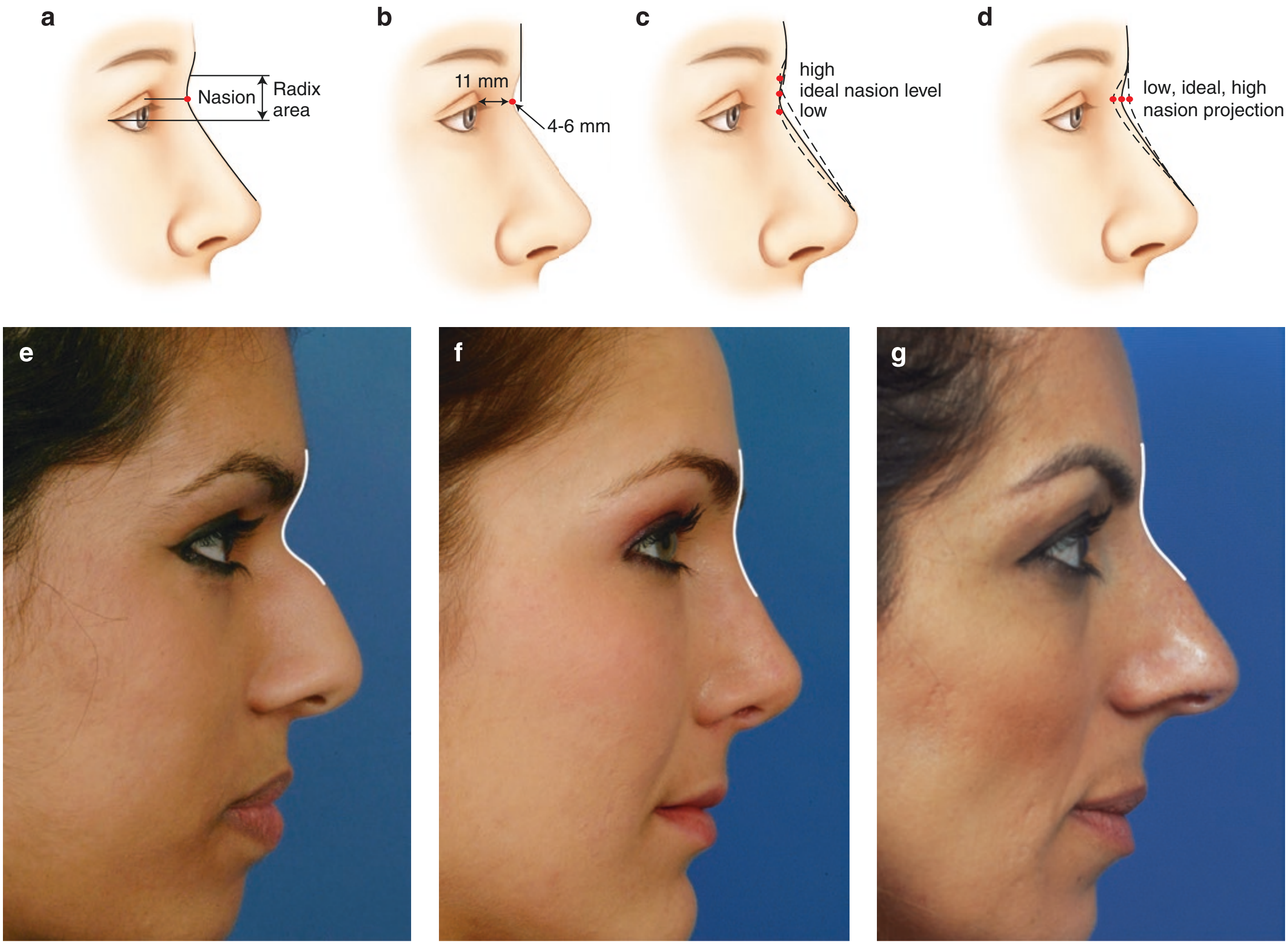


Fig. 3.3 (**a–d**) Radix and dorsal aesthetics. (**e–g**) Low, ideal, and high radix

A certain amount of confusion exists between the terms *sellion*, *nasion*, and *radix*. This conundrum has its origins in the difference between anthropometric and clinical terminology. Initially, *nasion* (N) was used to designate the deepest point on the nasal bones of dried skulls. In contrast, the term *sellion* (S) was used by anthropologists to identify the deepest soft tissue point in the nasofrontal angle. However, surgeons preferred the term *nasion* (N) and rarely used *sellion*. It is important to distinguish between the nasion point and the radix area. ***Nasion* (N)** refers to the deepest point of the *nasofrontal angle*. ***Radix*** refers to an area centered at the nasion, extending inferiorly to the level of the lateral canthus and superiorly for a comparable distance (Fig. 3.3). The ideal *nasion level* or vertical position is set between lash and crease line of the upper eyelid. The *nasion height* or projection can be measured from the vertical tangent to the cornea or glabella. These two factors determine the *nasion location*, which in turn sets the critical starting point of the nose with regard to the *nasofacial angle* and the *nasal length*. Establishing N allows the surgeon to take a balanced approach to the dorsal profile line; that is, augmenting the radix area increases N projection and allows one to maintain greater dorsal height.

RADIX AND DORSAL AESTHETICS

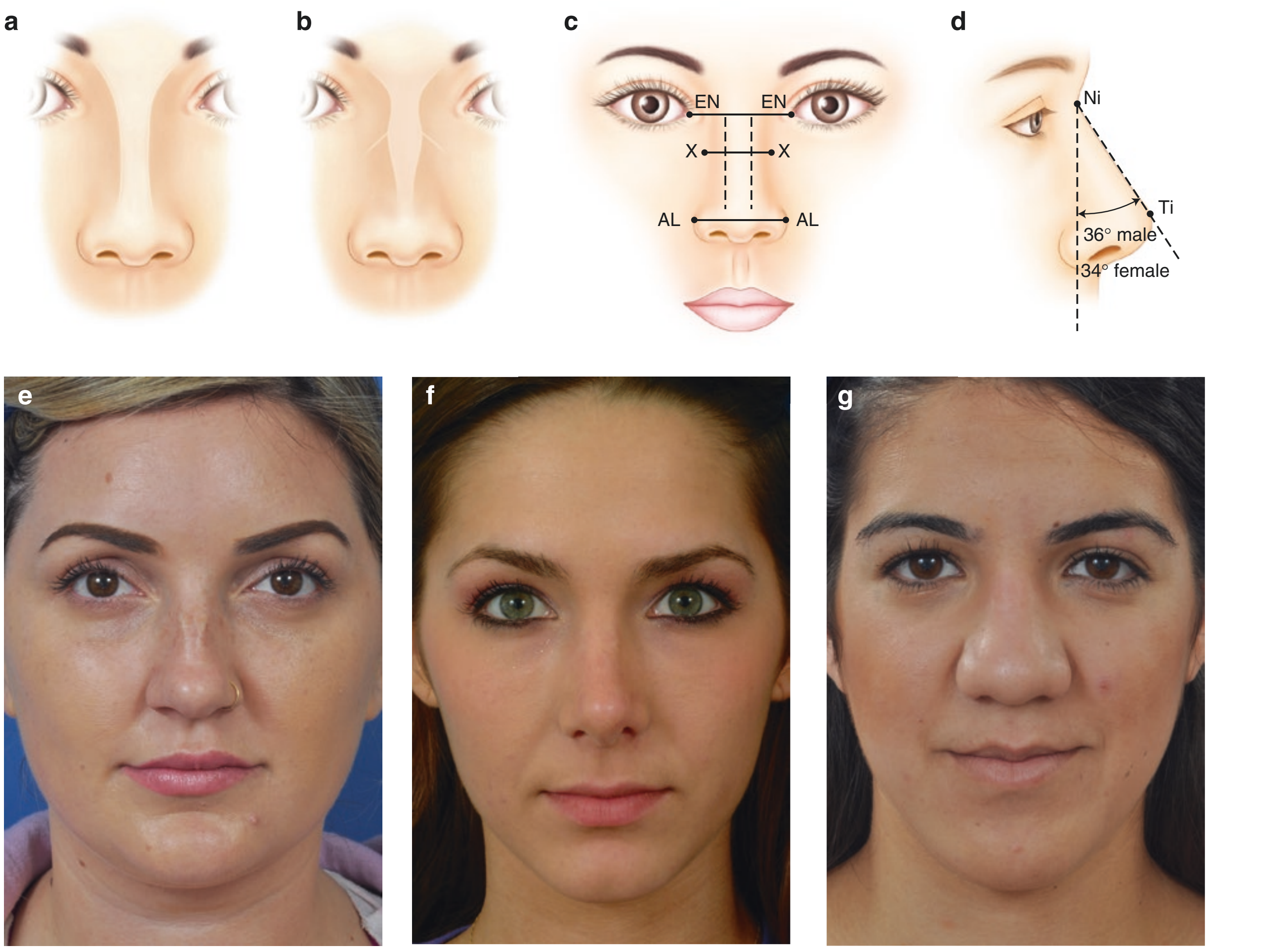


Fig. 3.4 (**a–d**) Dorsal aesthetics. (**e–g**) Range of dorsal lines: narrow, normal, and wide. *AL* alar flare; *EN* endocanthion; *Ni* ideal nasion; *Ti* ideal tip

The radix area is assessed primarily in lateral view, but dorsal analysis requires all three views. On anterior view, one assesses the dorsal lines, base bony width, and lateral wall inclinations. As emphasized by Çakir (2016), the dorsal lines begin at the supraorbital ridge, narrow at the radix, flare at the keystone junction, and taper down to the tip-defining points (Fig. 3.4). A general rule is that dorsal width should be 6–8 mm for females and 8–10 mm for males. A visual break in the continuity of the dorsal lines creates the inverted-V deformity that one can see following a rhinoplasty. The base bony width (X-point on either side, X–X for total width) is the widest point of the nose at the nasofacial groove. It is easily measured with a caliper. One compares base bony width (X–X) to the intercanthal width (EN–EN) to determine the need for, and the type of, lateral osteotomies. On oblique view, the opposite dorsal line should have a smooth sweep from orbit to tip, but is often broken by junctional irregularities. On lateral analysis, a *nasofrontal angle* (NFA) of approximately 34° for females and 36° for males is the accepted standard. The NFA is measured from a vertical through the ideal nasion and a line dawn from the nasion to the ideal tip. If a hump is present, the line is drawn through it. The final aesthetic line is often concave for females and straight for males. Second, there is a relatively ideal dorsal height, which is independent of the angles. A classic example is the patient with a low radix and underprojecting tip, whose intervening dorsum appears quite prominent. The balanced approach is to graft both the radix and the tip, with minimal reduction of the dorsum.

THE BONY VAULT AND PYRIFORM APERTURE

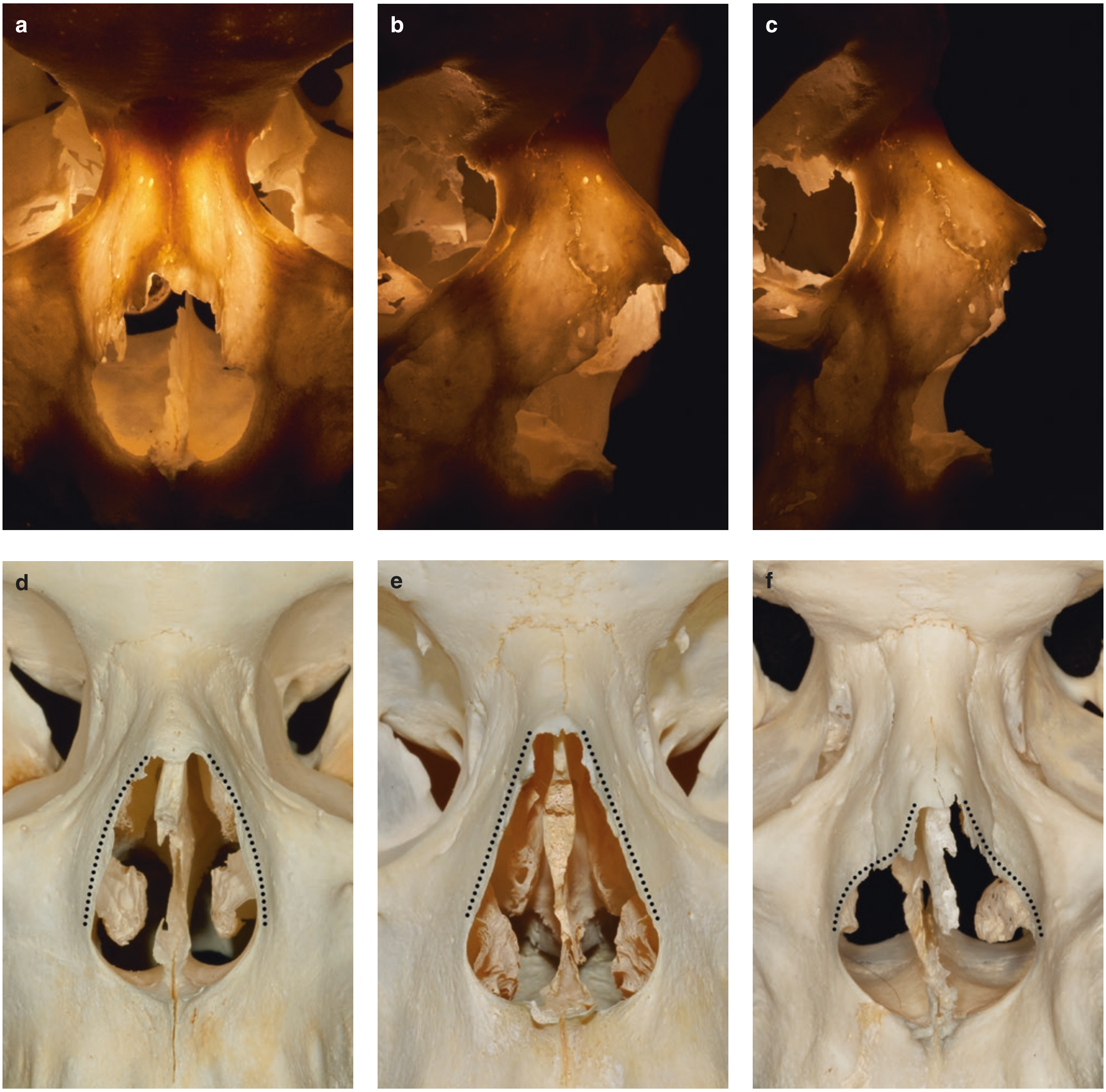


Fig. 3.5 The bony vault. (**a–c**) Transillumination reveals the thick and thin areas. (**d–f**) Convex, straight, and concave lateral bony wall along the pyriform aperture

The *bony vault* refers to the bony framework of the nose, containing the paired nasal bones and the frontal processes of the maxilla. The bony vault can be divided vertically into a cephalic and caudal portion. The cephalic portion is above the medial canthal ligament; this area is the radix of the nose. The bone in the radix area is a fused, solid triangle of multiple bones, which can be reduced only with difficulty. The bone has the contour of the nasofrontal angle within it. Preoperatively, it is important to differentiate by palpation whether radix fullness is due to soft tissue or bone. The bony vault has a different thickness in different areas, and the thickest part is in the cephalic radix area. Transillumination reveals the thick and thin parts of the vault (Fig. 3.5a–c). The pattern influences the location of lateral osteotomies. The base bony width can vary from narrow to wide, and the form can vary from concave to convex (Fig. 3.5d–f).

THE BONY VAULT (LATERAL BONY WALL)

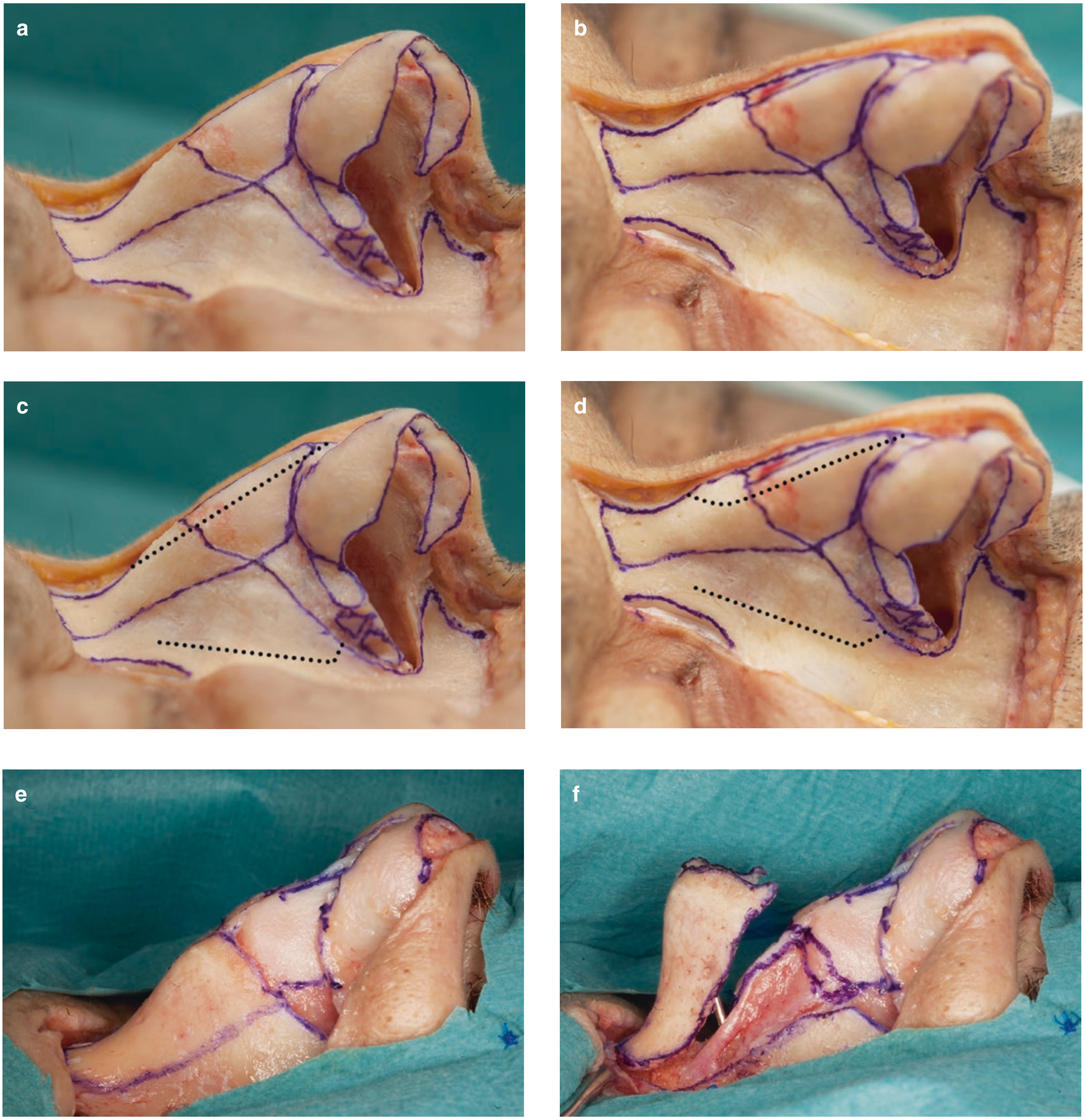


Fig. 3.6 (**a**–**d**) Components of the lateral bony nasal wall. (**e**, **f**) The nasal bones elevated, showing cartilage overlap

The term ***lateral bony wall*** denotes the contribution of both the **frontal process of the maxilla** and the **nasal bones.** One can conceive that bony hump removal is confined to the nasal bones, and all lateral osteotomies pass within the frontal process of the maxilla. As seen in Fig. 3.6a, b, the reciprocal size relationship between the frontal process of the maxilla and the nasal bone is obvious: the larger the frontal process, the smaller the nasal bones. Also, the lateral extent of the ULC closely corresponds to the suture line between the nasal bone and the frontal process of the maxilla. As seen in Fig. 3.6e, f, the nasal bones are fused in the midline and can be raised like a car hood from the underlying cartilaginous vault.

THE BONY CAP

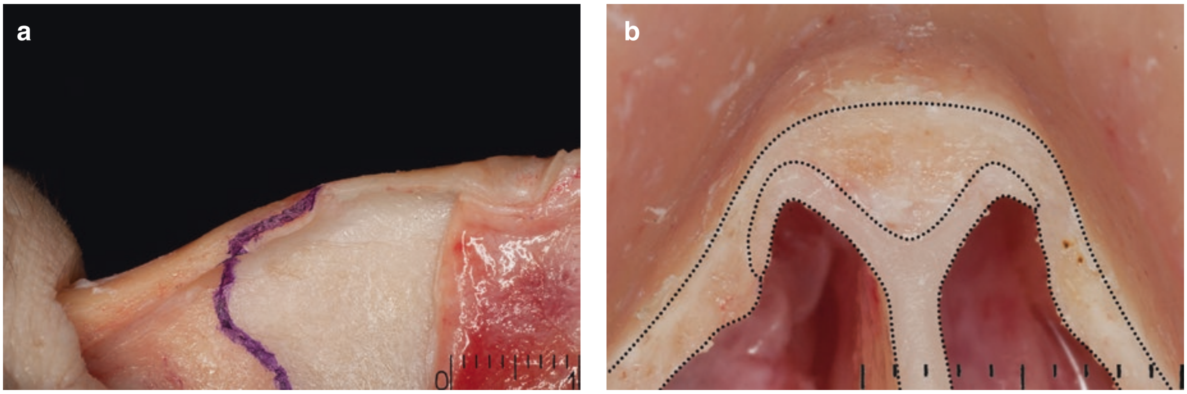


Fig. 3.7 (**a**, **b**) Paramedian and transverse cut of the dorsal keystone area shows the bony cap along the dorsal nasal lines

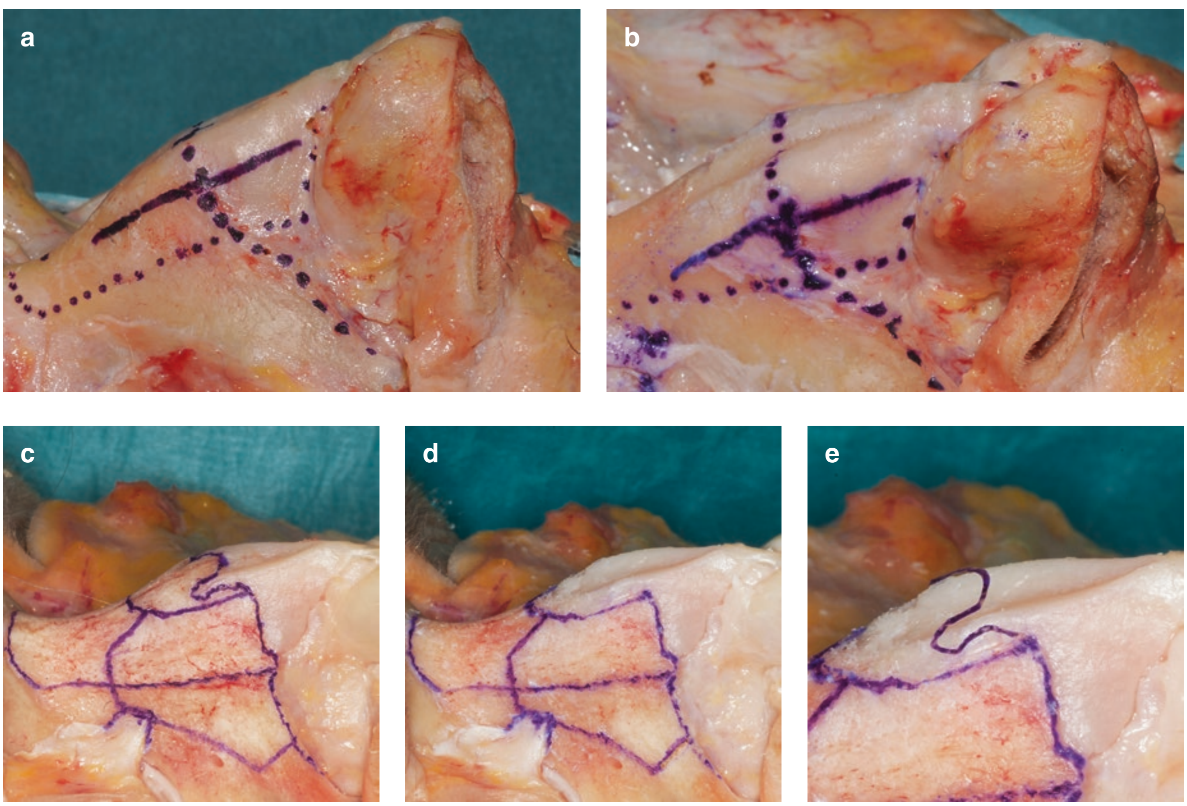


Fig. 3.8 (**a**–**e**) Removal of 12 mm of bony cap exposes the intact underlying cartilaginous vault. Note that there is no open roof

For too long, rhinoplasty surgeons were obsessed with removing a large hump using chisels or osteotomes to remove an en bloc osseocartilaginous hump. Our anatomical studies (Palhazi et al. 2015) demonstrated that the nasal bones form a thin *bony cap* over the underlying cartilaginous vault. As measured along the dorsal nasal lines, the bone averages only 0.7 mm (range, 0.5–1.0 mm) in thickness at the keystone junction (Fig. 3.7). Embryologically, growth of the nose occurs from the anterior–posterior expansion of the septum rather than from growth of the nasal bones themselves. During puberty, the cartilaginous nasal septum functions as the dominant growth center of the midface. The nasal hump results from the upward thrust of the underlying cartilaginous vault rather than an equal contribution from the nasal bones and cartilage. We conclude that ***there is no bony hump, only a bony cap*** that covers a cartilaginous hump (Fig. 3.8).

THE BONY CAP: SURGICAL IMPLICATIONS

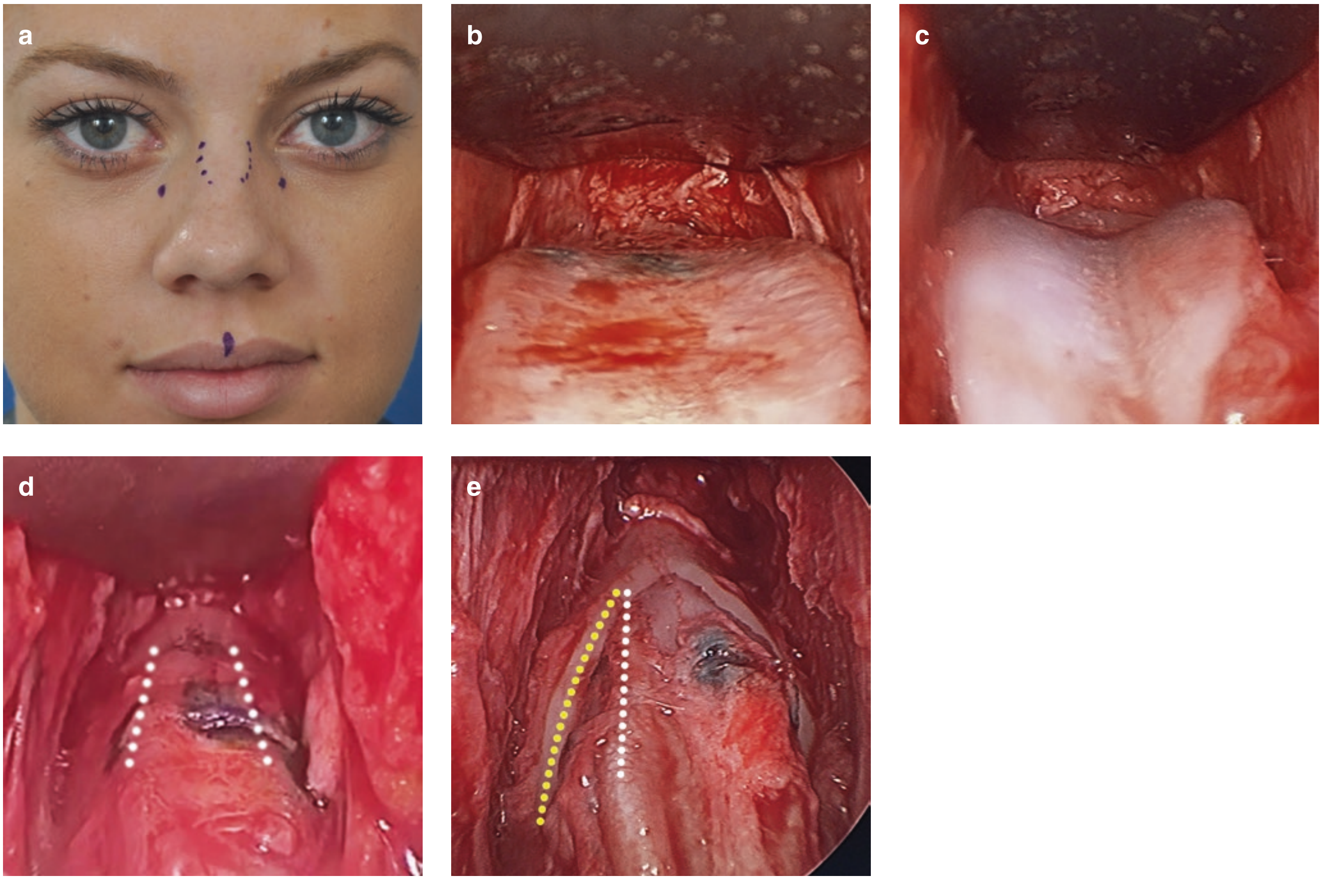


Fig. 3.9 The bony cap. (**a**) Patient complained of her dorsal irregularities. (**b**, **c**) Exposure beneath the superficial musculo-aponeurotic system (SMAS), followed by subperichondrial dissection, reveals a direct correlation between the surface dorsal lines and the cartilaginous vault through the thin bony cap. (**d**, **e**) Dorsal lines are reflected in the cartilaginous vault (*white dotted line*) before rasping, and are defined by the nasal bones (*yellow dotted line*) after rasping

The surgical implications of the bony cap concept are three: (1) The hump removal sequence should be *bone first, then cartilage.* (2) The bone should be removed as atraumatically as possible. (3) The underlying cartilaginous vault should be preserved. Figure 3.9 shows the osseocartilaginous junction before and after its removal, revealing an intact cartilaginous vault. In other words, the shape of the dorsum is governed by the cartilaginous vault, not its bony coverage. Essentially, the aesthetic dorsal lines are a surface expression of the intrinsic shape of the cartilaginous vault. Once the bony cap is removed atraumatically, one can see the intact cartilaginous vault (Fig. 3.9c). Splitting off of the ULCs prior to dorsal septal reduction will allow them to be used to close the open roof *within* the bony vault. Previously, the 8–10 mm of the cartilaginous vault cephalic to the keystone junction was removed with the overlying bony cap as part of bony hump removal. By preserving the underlying cartilage, one can now utilize it, sewing them as spread flaps to completely close the open roof. In addition, careful attention must be given to straightening any septal deviation and achieving maximum symmetry of the ULCs.

THE CARTILAGINOUS VAULT

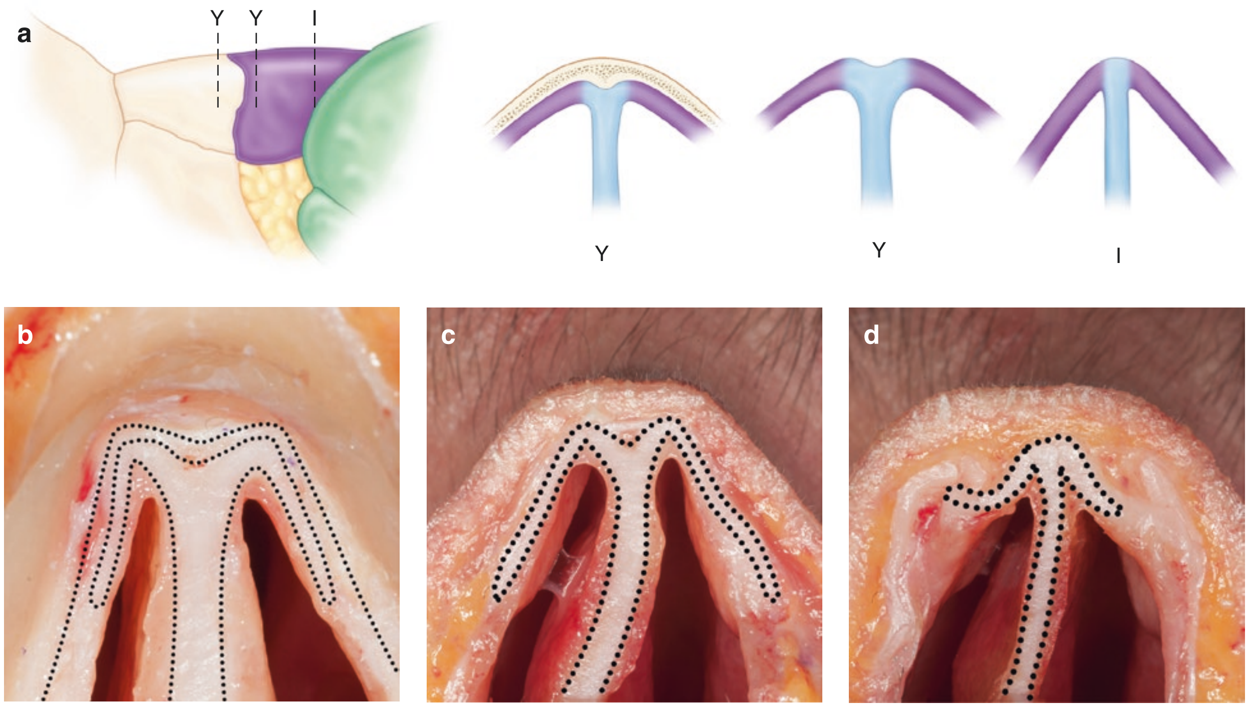


Fig. 3.10 (**a–d**) Junction of the septum and upper lateral cartilage (ULC) along the dorsum. Cross-sections show the progression from Y to I form

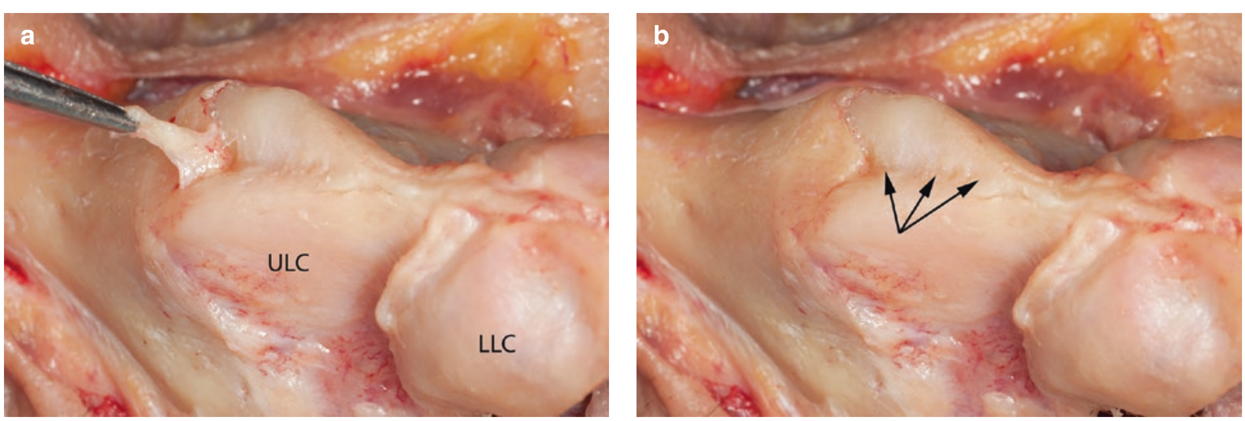


Fig. 3.11 (**a–b**) The supraseptal groove is filled with adherent fibrous tissue of perichondrial and periosteal fibers

Perhaps the greatest anatomical misunderstanding in the entire nose concerns the cartilaginous vault, which is a single anatomical entity, not a septum with two juxtaposed ULCs. Reduction of the cartilaginous dorsum permanently destroys the normal architecture and creates a tripartite entity, which can be visible as an inverted-V deformity. Spreader grafts and spreader flaps are an attempt to reconstruct normal nasal anatomy. Another important point is the change in the shape of the cartilaginous dorsum as it progresses from a broad "Y" or "T" shape beneath the bony dorsum to a "Y" shape at the mid vault and to a narrower "I" caudally (Fig. 3.10). It should be noted that there is a distinct *cleft* between the ULC and the dorsal septum, called the *paraseptal cleft* (Fig. 3.11). As measured from the K-point to the caudal-point, the ULC length averages 15.8 mm (range, 11–21 mm) along the dorsum. The paraseptal cleft extends 6.2 mm (range, 3–14 mm) from the caudal-point cranially; thus roughly half the length of the ULC is separated from the septum. Despite our recognition of the single-entity concept of the cartilaginous vault, we are forced surgically to speak of the ULCs and the dorsal septum.

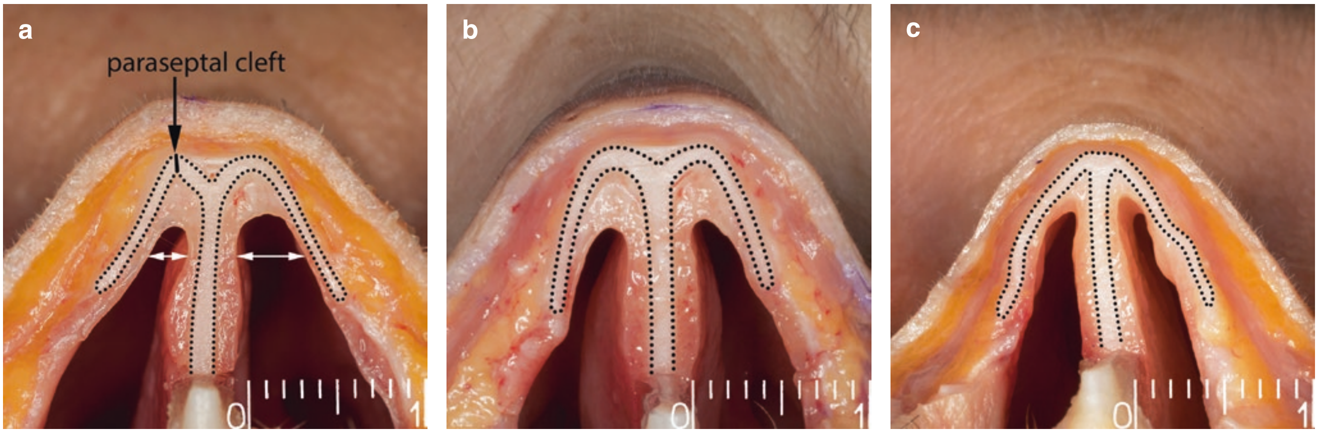


Fig. 3.12 Cross sections of the ULC–septum junction 5 mm caudal to the K-point (same scale). (**a**) Y-shape midvault with cleft (*right side*) and without cleft (*left side*). (**b**) Y-shape midvault without cleft. (**c**) I-shape midvault

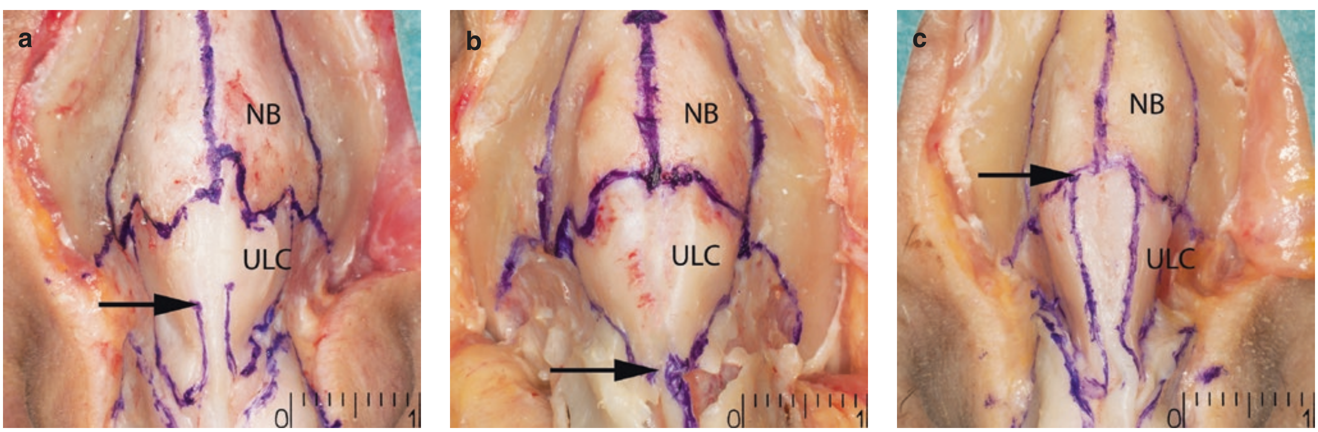


Fig. 3.13 The paraseptal cleft (*arrow*) between the ULC and dorsal septum can be (**a**) partial, which is most common; (**b**) minimal; or (**c**) complete. *NB* nasal bone

Straatsma and Straatsma (1951) studied the relationship between the ULC and the dorsal septum in both gross dissection and histological specimens. They found that a *cleft* existed between the ULC and the dorsal septum in its most caudal two thirds, whereas the two cartilages were fused in the upper one third. The fibrous tissue in the cleft was perichondrium (Fig. 3.12), and the width of the cleft narrowed with cephalic progression. As shown in Fig. 3.13, the cleft can range in length from minimal to complete.

Surgeons tend to think of the cartilaginous vault only as it relates to dorsal reduction and reconstruction. Yet the lateral and distal portions of the cartilaginous vault are of equal importance. In general, the lateral border of the ULC corresponds to the caudal border of the suture line between the nasal bones and the frontal process of the maxilla. Its relative lateral extension has a reciprocal size relationship to the size of the mucosal space: the larger the cartilage, the smaller the mucosal space. The caudal border of the ULC is the scroll junction with the lower lateral cartilage (LLC) and is of paramount importance in establishing the internal valve. Thus, the cartilage vault is critical aesthetically in establishing the dorsal aesthetic line and functionally in contributing to the internal valve.

THE OSSEOCARTILAGINOUS "KEYSTONE"

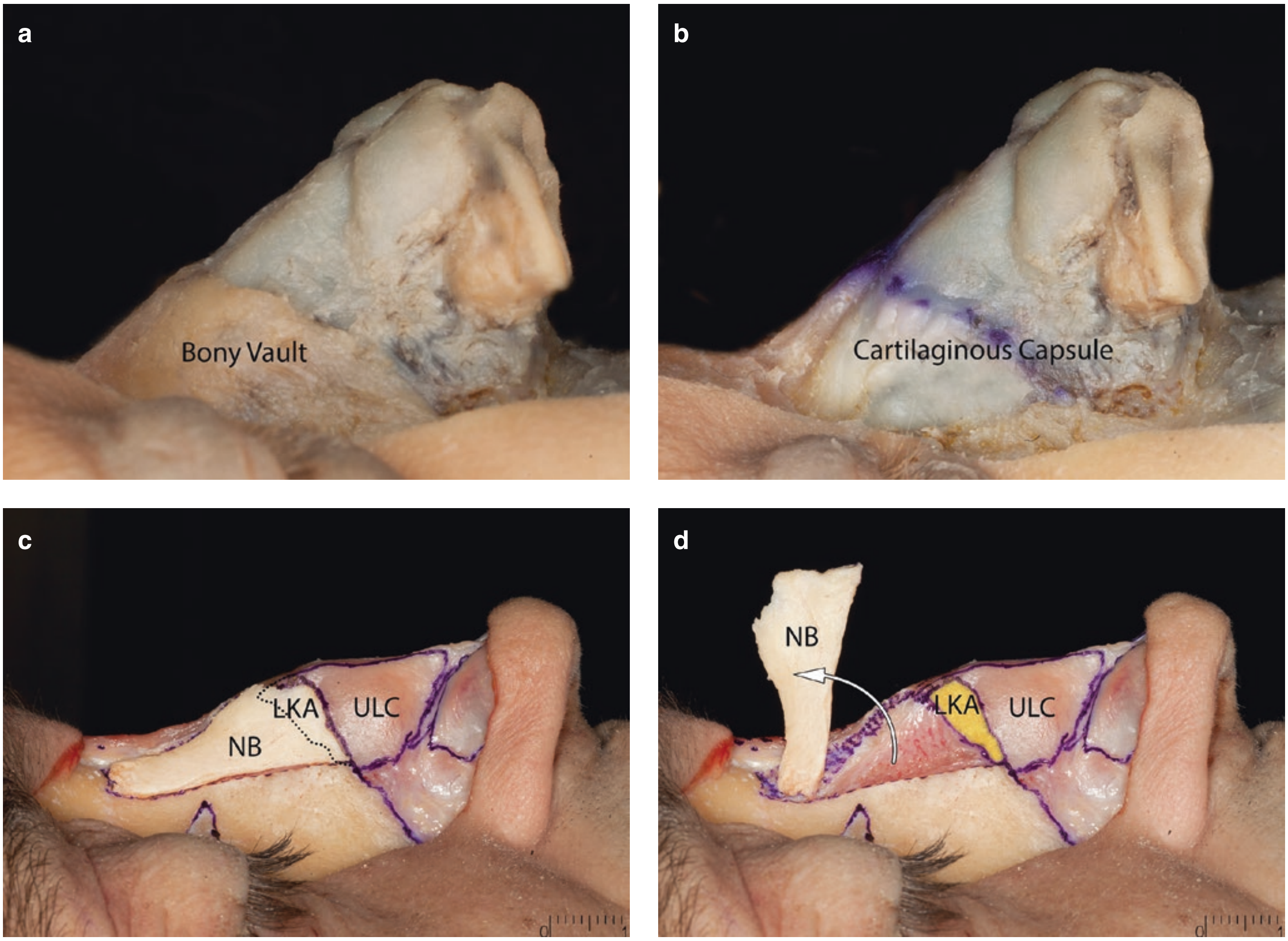


Fig. 3.14 (**a**, **b**) Dissection of a fetal nose reveals the cartilaginous capsule with no bony coverage. (**c**, **d**) Elevation of the adult nasal bones (NB) reveals the cartilaginous vault with the intrinsic underlying cartilaginous hump. *LKA* lateral keystone area

The anatomy of the osseocartilaginous vault reflects its embryology. The laying down of the nasal bones over the cartilaginous capsule is reflected in the broad overlap of the bony and cartilaginous vault (Fig. 3.14). The cartilaginous capsule absorbs cephalically, and its remaining parts will be the cartilaginous vault. Thus, the bony and cartilaginous vaults are not simply joined at a seam, but rather have an overlapped integration. This relationship is a "chondro-osseous joint" with the bony cap separated from the cartilaginous vault by a layer of fused periosteum and perichondrium. One of the great surgical misconceptions is that rasps can avulse the ULC. Histologically, the periosteum of the nasal bones and the perichondrium of the ULC are fused, which makes avulsion virtually impossible. When one sees clinically a depression along the lateral keystone area (LKA), it is not an avulsion of the ULC, but rather a vertical fracture of the nasal bones, marking the cephalic extent of the ULC. Anatomically, the caudal portion of the nasal bones that overlaps the ULC is quite thin, and fractures occur at this point. The importance of the cartilaginous and bony overlap is evident in reduction rhinoplasty, as the hump is far more cartilaginous than bony. Technically, the implication is that rasping the bony hump (bony cap) first brings the larger underlying cartilaginous hump into relief and avoids over-resection of the bony dorsum. In childhood, nasal height is due mainly to the nasal bones. During puberty, the nose undergoes radical changes from the forward thrust of the maxilla and the absorption and deposition along the nasal profile line. Thus, lateral osteotomies are done within, or pass across, the frontal process of the maxilla in order to narrow the base bony width.

THE OSSEOCARTILAGINOUS "KEYSTONE"

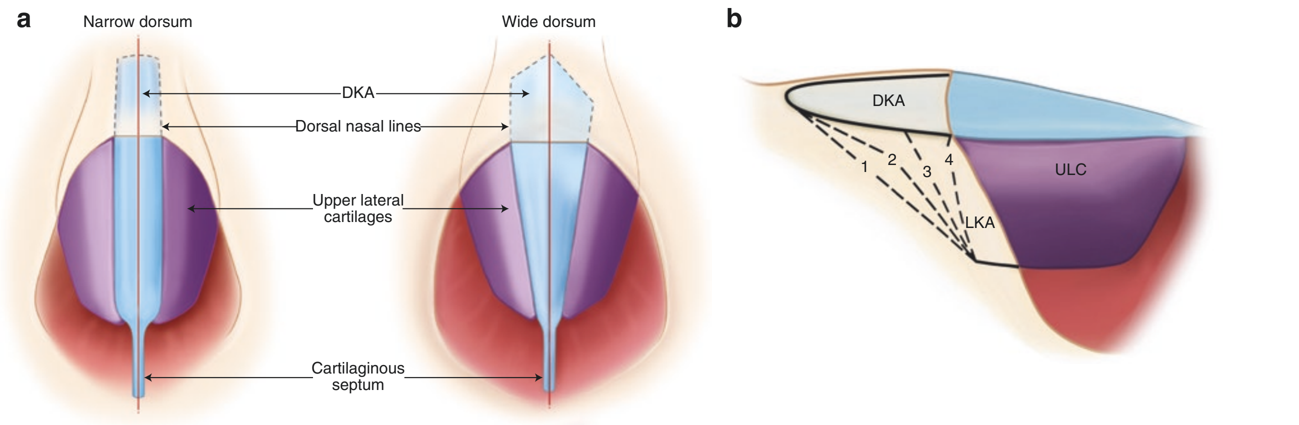


Fig. 3.15 (**a**) Different width of the dorsal keystone area (DKA). (**b**) Transition of the DKA into LKA

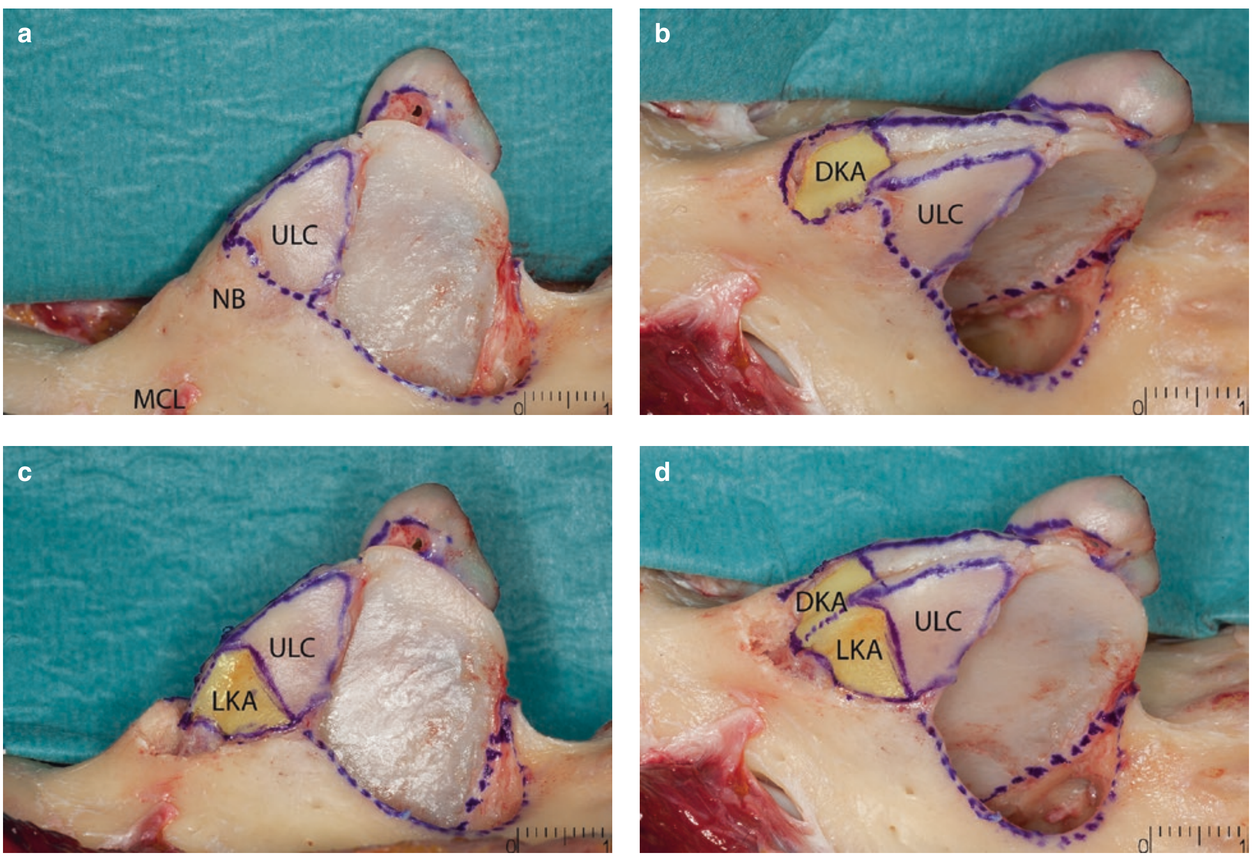


Fig. 3.16 (**a**–**d**) DKA and LKA. (**a**) Bony cap intact. (**b**) Removal of bony cap dorsally with rasping. (**c**, **d**) Removal of the entire nasal bone to show the extent of the underlying cartilaginous vault. *MCL* medial canthal ligament

The **keystone area** can be divided into a dorsal and lateral keystone area. The *dorsal keystone area* measures 9 mm in the midline (range 4–14 mm) for the general population (Fig. 3.15). The *lateral keystone area* (LKA) is created by the overlap of the ULCs and nasal bones (Fig. 3.16). The degree of overlap is highly variable, but the greatest longitudinal overlap occurs along the dorsum. In most dorsal reductions, the osseocartilaginous junction is permanently removed in the midline and the new osseocartilaginous junction moves cephalically towards the nasion. Clinically, the mucosa cephalic to the cartilaginous vault is rarely exposed following removal of the bony cap. Laterally, the bony–cartilaginous junction moves caudal and posterior, owing to the slope of the pyriform aperture.

RADIX SURGERY—RADIX AUGMENTATION

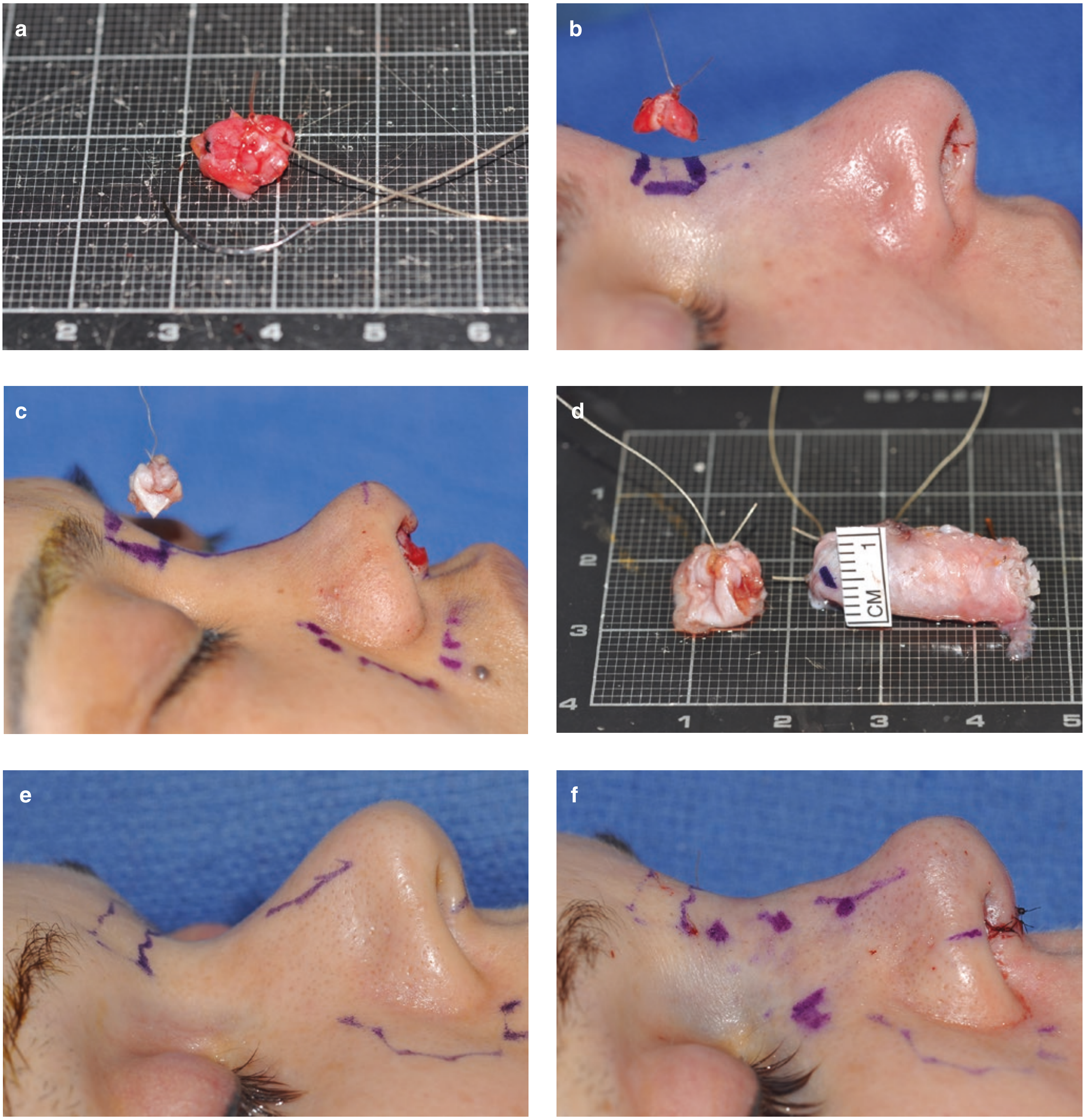


Fig. 3.17 (**a**, **b**) Radix augmentation. (**c**) Glabellar graft. (**d–f**) Glabellar–radix–upper dorsal graft, including a diced cartilage in fascia (DC-F) graft

Radix augmentation is a critical component of a balanced dorsal reduction: the more one augments the radix, the less one must reduce the dorsum. In general, fascia will suffice for most radix augmentations. There is no need to use solid grafts of cartilage, as the risk of visibility and asymmetry is simply too great. The surgical technique is simple—ball up a sheet of fascia, suture with a 4-0 plain catgut, slip the needle into the pocket, and guide the fascial ball into the pocket. One can over-graft by 20% without concern (Fig. 3.17a, b). A diced cartilage in fascia graft (DC-F) is used when larger grafts are required or they must extend down towards the keystone junction (Fig. 3.17d–f). Essentially, a contoured "bean bag" of DC-F is made and slipped into the pocket. The critical step is to make sure the junction with the dorsum is smooth. Do not over-graft with DC-F, as what you see on the table is what you see postop.

RADIX REDUCTION

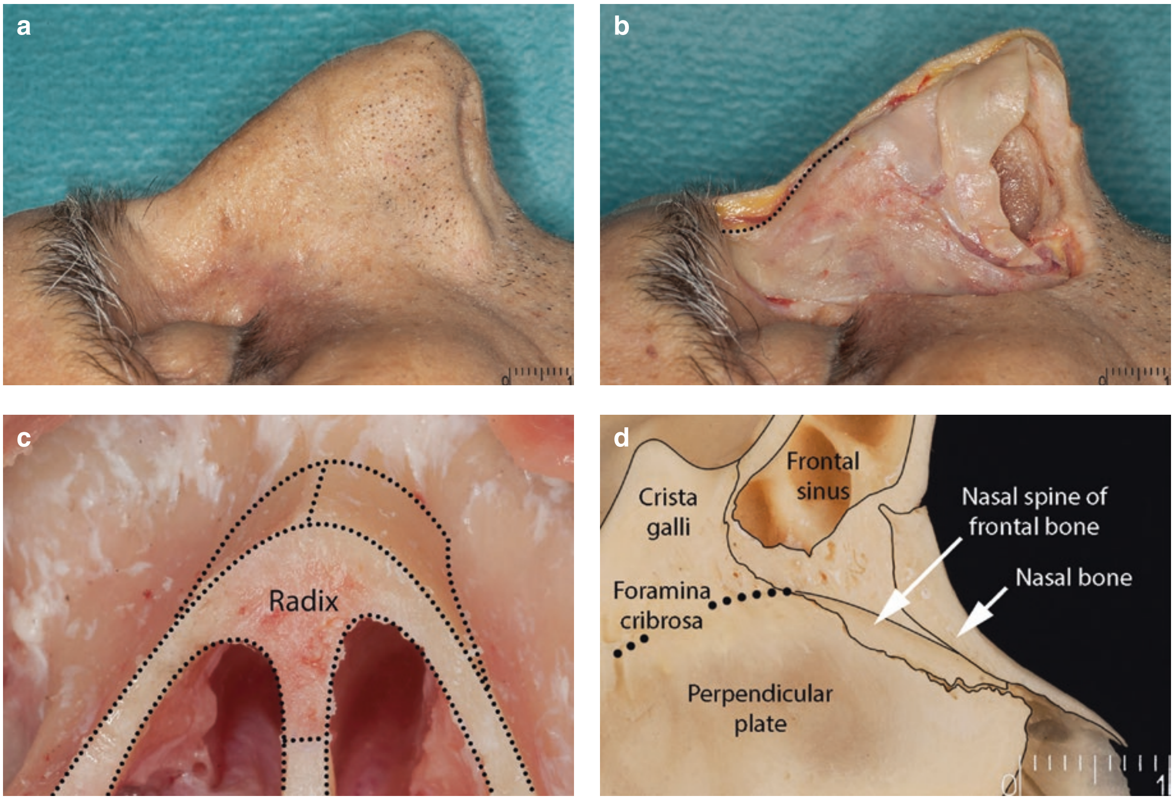


Fig. 3.18 (**a**–**b**) Anatomy of a high radix. (**c**) Bone thickness in the radix area. (**d**) Paramedian cross-section of the bony vault, showing the radix composition

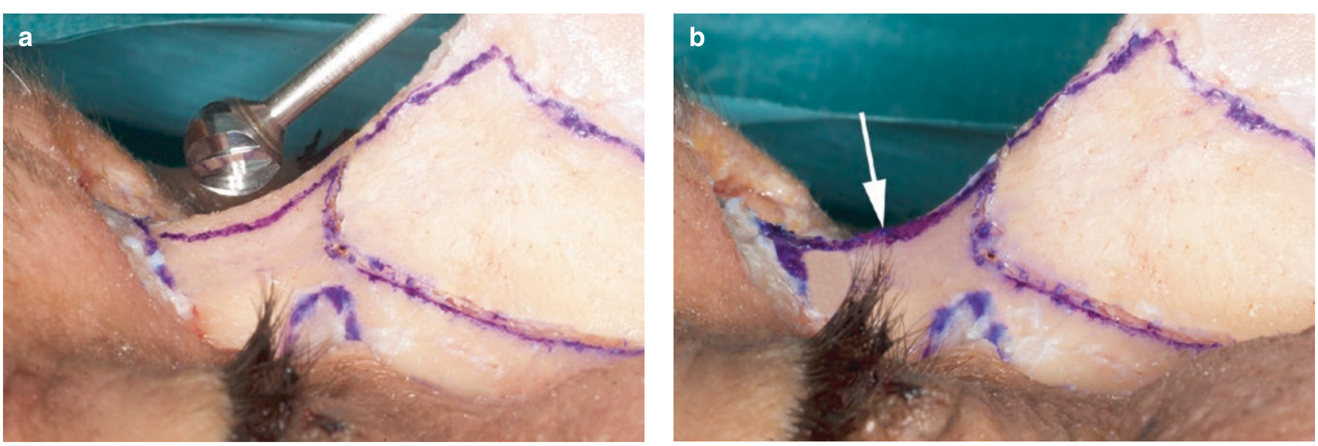


Fig. 3.19 (**a**, **b**) Bony radix reduction using power burr

Radix reduction falls into two categories: soft tissue or bone. Preoperatively, one should palpate and squeeze the soft tissue of the radix to determine its composition (Fig. 3.18). The following technique has proven effective for soft tissue reduction: (1) skin elevation over the radix and glabella areas; (2) a comparable subperiosteal dissection; (3) en bloc excision of the intervening muscle and subcutaneous fat; (4) insertion of a 7 Fr drain, which suctions the skin against the bone; and (5) application of a plaster of Paris cast extending unto the forehead. Cast compression must be removed carefully at 1 week to minimize skin elevation. Bony reduction is more demanding and requires extensive subperiosteal elevation. The dorsal hump is removed first. Then the radix area is deepened using either piezoelectric instruments or a power burr (Fig. 3.19).

RADIX AUGMENTATION (CASE STUDY)

Analysis: A 28-year-old woman complained about her bump on profile and wide, heavy tip. Analysis indicated that the nasion was at her midpupil (low level) and far back from a vertical line tangent to her glabellar (low height). Surgical correction would require a balanced approach with emphasis on augmenting the radix and increasing tip projection, rather than relying solely on dorsal reduction (Fig. 3.20).

Operative Technique:

1) Fascia harvest. Open approach. Septal exposure through a unilateral transfixion incision.
2) Dorsal reduction (B 1 mm, C 2.5 mm). No caudal septal resection.
3) Septal harvest followed by L-to-R caudal septal relocation. Partial inferior turbinate reduction (Coblation).
4) Medial oblique and L–L osteotomies. Bilateral spreader grafts.
5) Insertion of a columellar strut. Tip sutures: CS, DC, ID, DE, LCCS, TP (*see* Chap. 2).
6) Placement of a 0.2-cc DC-F "bean bag" graft to the radix area.

Commentary: The balanced approach allowed a limited dorsal reduction (2.5 mm) and preservation of the dorsal height in this 5′9″ tall patient with strong facial features (Fig. 3.21). The alternative of reducing her dorsum to her preoperative nasion would have been devastating. Tip support moved her intrinsic projection from c′ to T. On oblique view, the nasal tip is narrower and more refined following tip suturing under moderately thick skin.

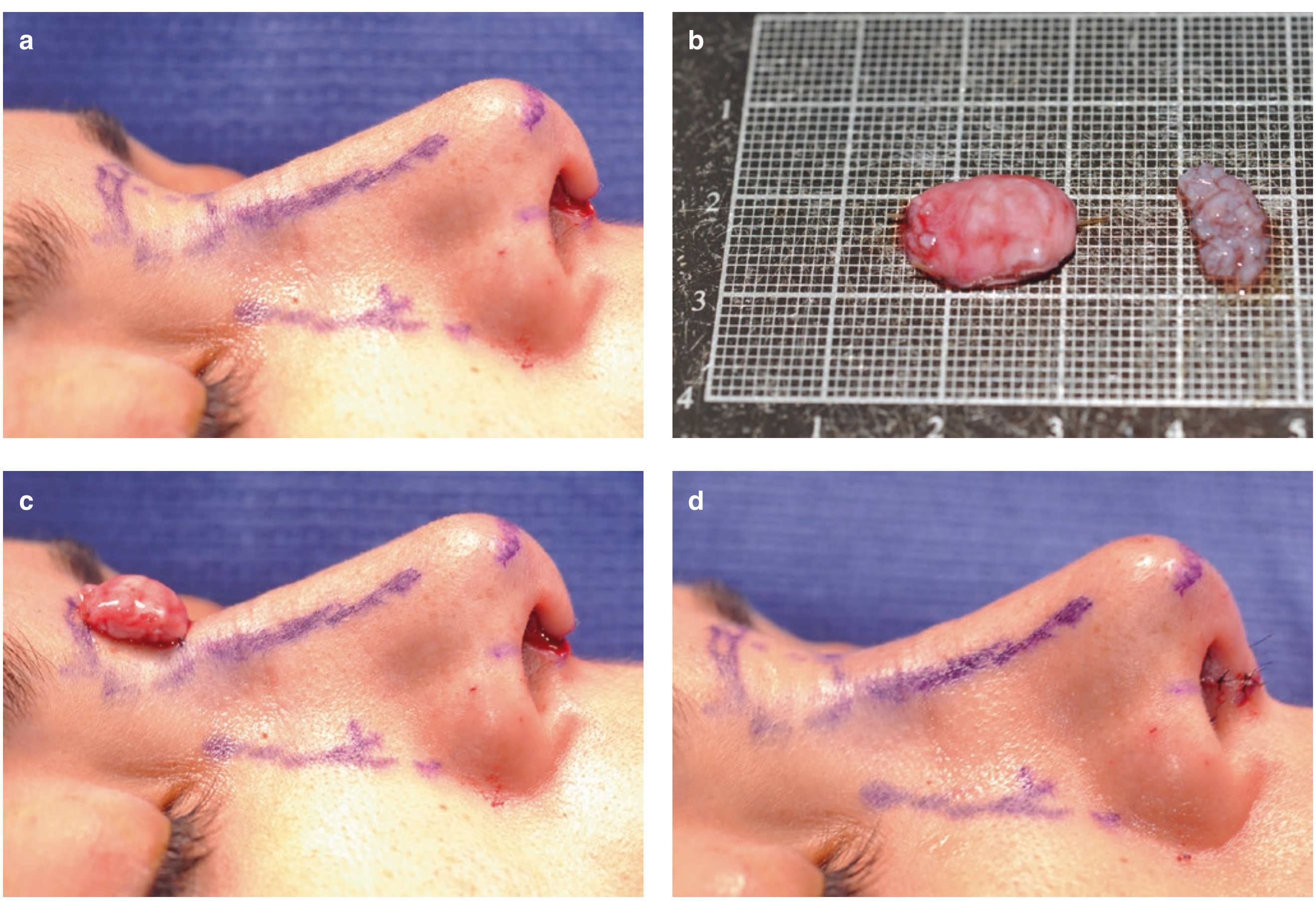


Fig. 3.20 (**a–d**) Radix augmentation, including placement of a DC-F graft

RADIX AUGMENTATION (CASE STUDY)

Fig. 3.21 (**a–h**) Patient in case study, before (*left*) and after (*right*) radix augmentation surgery

RADIX REDUCTION (CASE STUDY)

Analysis: An 18-year-old male hairdresser felt his nose was too big for his 5′4″ frame. Specifically, he considered the nose too big, too wide, and the tip too droopy. His nasion (N) was quite high and above his superciliary fold. Dorsal reduction would require a two-step approach (Fig. 3.22), first achieving the ideal dorsal profile line and then reducing the radix area, moving the nasion to a lower level and bringing it inward toward the pupil, thus reducing its height.

Operative Technique:

1) Open approach. Reduction of the massive lateral crura from 13-mm wide to 6-mm rim strips.
2) Dorsal rasping using a power rasp, followed by resection of the anterior septum (4 mm at ASA, 1.5 mm keystone).
3) Additional rasping in a cephalic direction. Radix bone reduction using a 2-mm power burr.
4) Medial oblique and bilateral double-level osteotomies.
5) Insertion of 2.4-mm spreader grafts extending high into the bony vault.
6) Modified tongue-in-groove procedure to control columellar inclination.
7) Insertion of a short columellar strut. Tip sutures: CS, DC, ID, DE.

Commentary: There was nothing easy about this case. It was necessary to reduce the radix and osseocartilaginous vault as much as possible to achieve a more desirable profile (Fig. 3.23). Not only was dorsal reduction necessary, but also columellar and tip rotation.

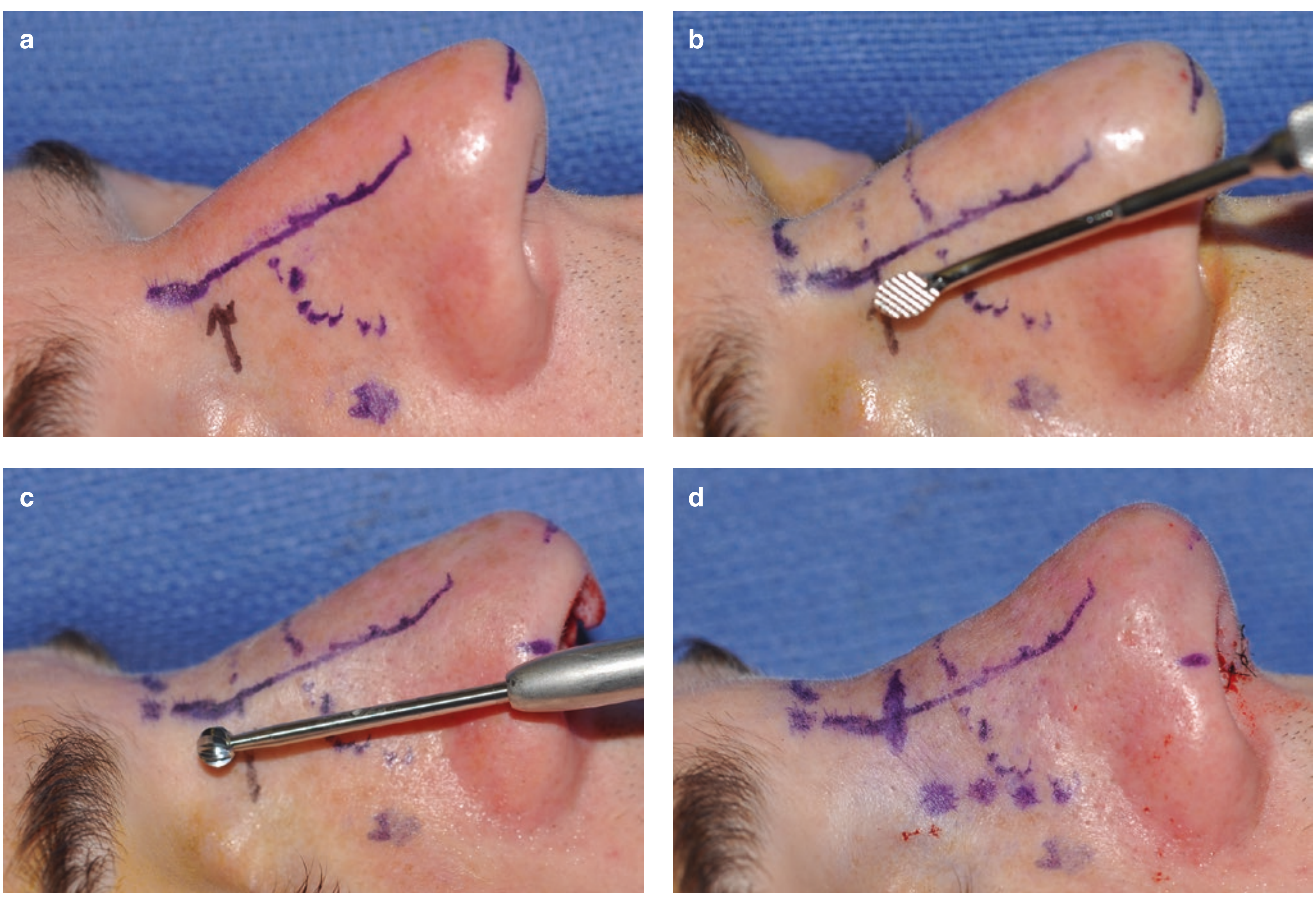


Fig. 3.22 Two-step approach to dorsal reduction. (**a**) Dorsal profile. (**b**) Power rasping of the bony cap area. (**c**) Power burr to reduce radix. (**d**) Final profile change

RADIX REDUCTION (CASE STUDY)

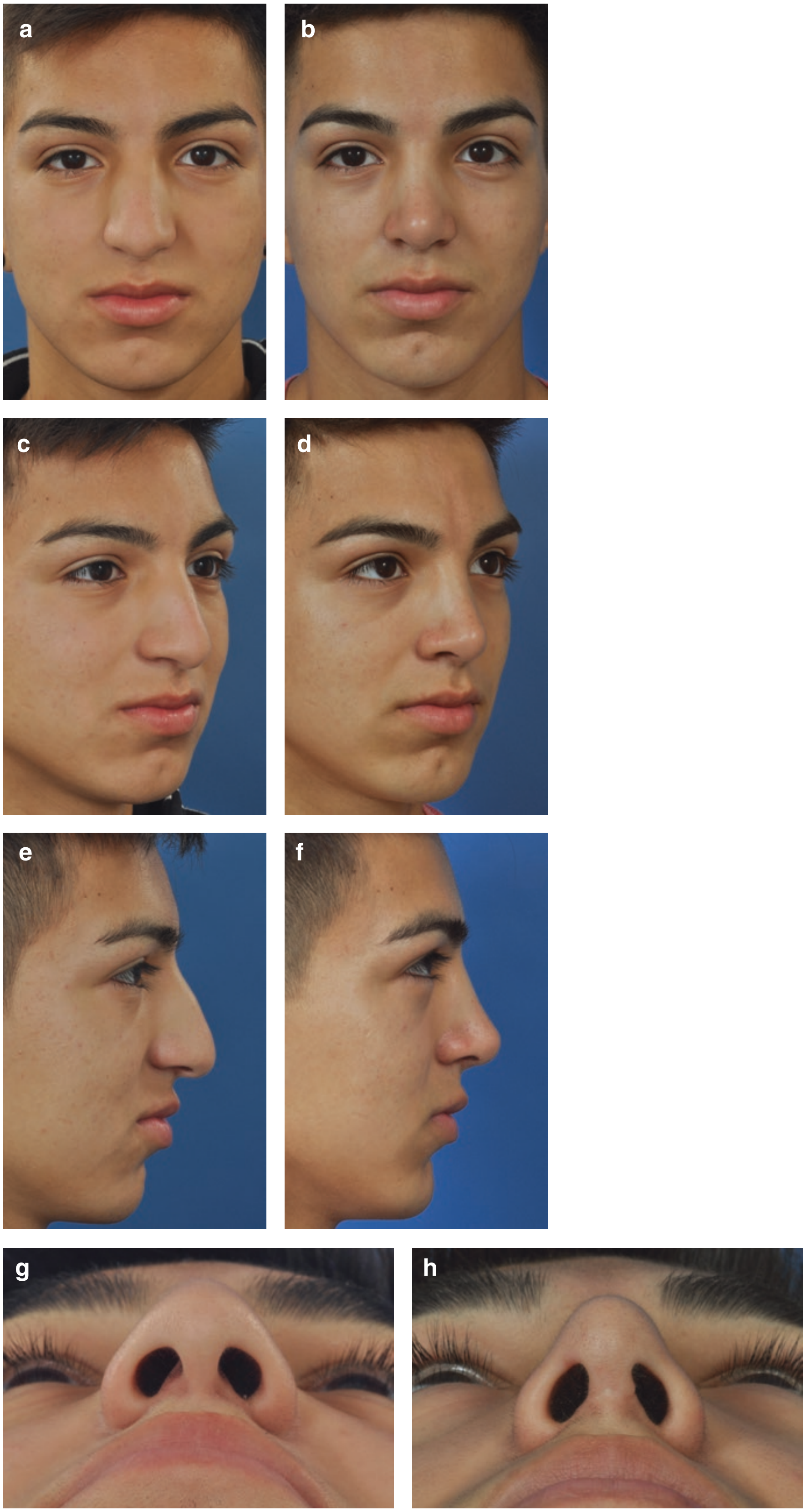


Fig. 3.23 (**a–h**) Patient in case study, before (*left*) and after (*right*) radix reduction surgery

DORSAL REDUCTION

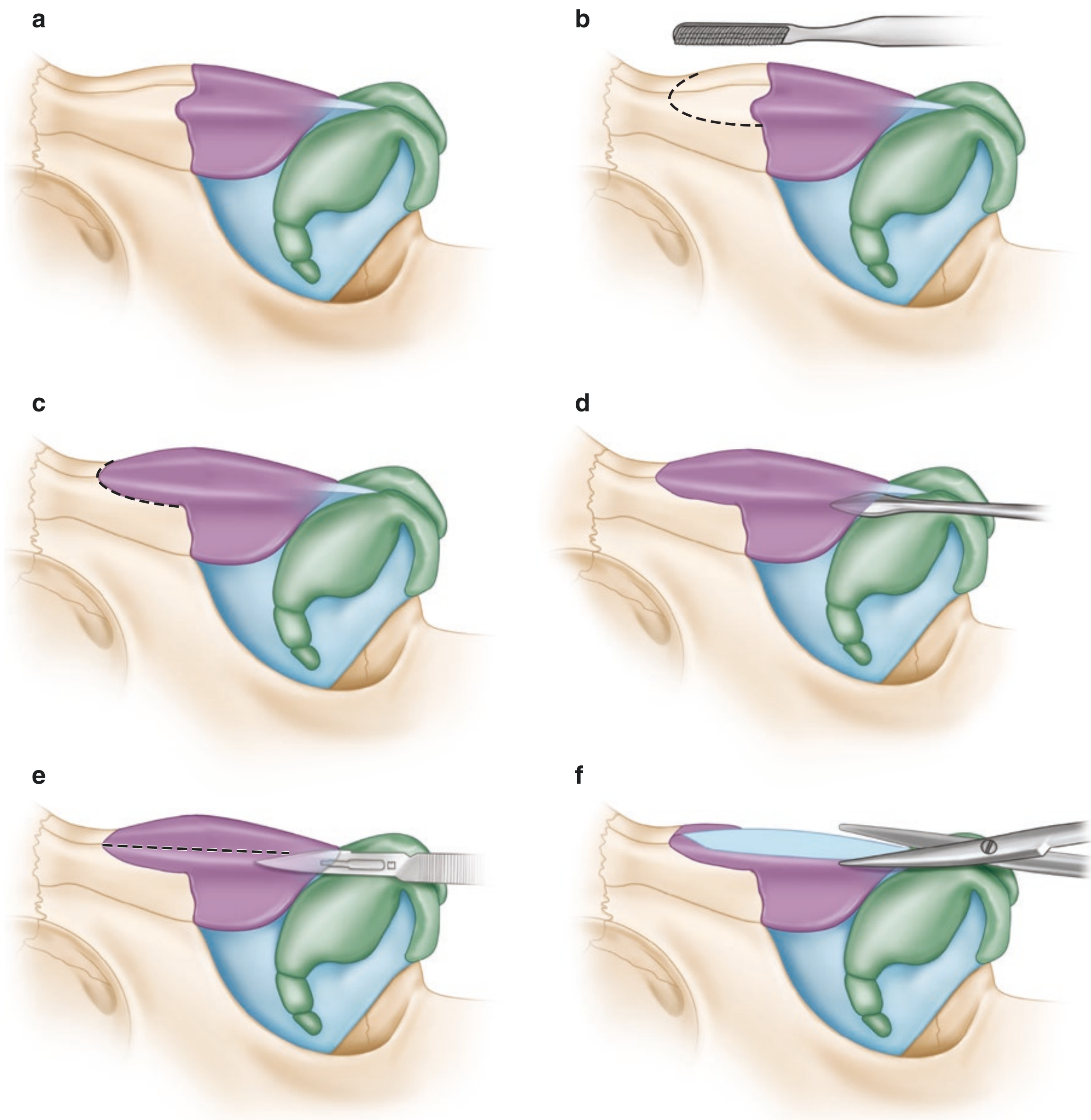


Fig. 3.24 (**a–f**) Component split-hump reduction sequence

Clinically, decisions must be made regarding sequence and method of dorsal reduction. Historically, an en bloc resection of the entire osseocartilaginous vault was done with a guarded osteotome, but this method led to excessive hump removal and was abandoned. Next, surgeons began doing a sequential resection. First, they removed the cartilage vault with a sharp knife and then used a chisel to remove the bony hump. This method often resulted in "junctional disharmony." The idea of a "split hump reduction" technique, as championed by Daniel, involves removing the bony component first, followed by cartilage reduction after splitting off the ULC. Essentially, hump reduction was split into two steps: bone before cartilage, and the literal splitting off of the ULC before dorsal reduction (Figs. 3.24 and 3.25). Based on the *bony cap concept*, it is obvious that the bony cap should be rasped off first, leaving the cartilaginous vault intact. Next, the ULCs are separated from the dorsal septum after making extramucosal tunnels. Then the anterior dorsal septum is excised with scissors to achieve the desired profile line. Because the ULCs have been preserved, they can be used as spreader flaps. This approach allows maximum preservation of tissue and is done in a graded fashion.

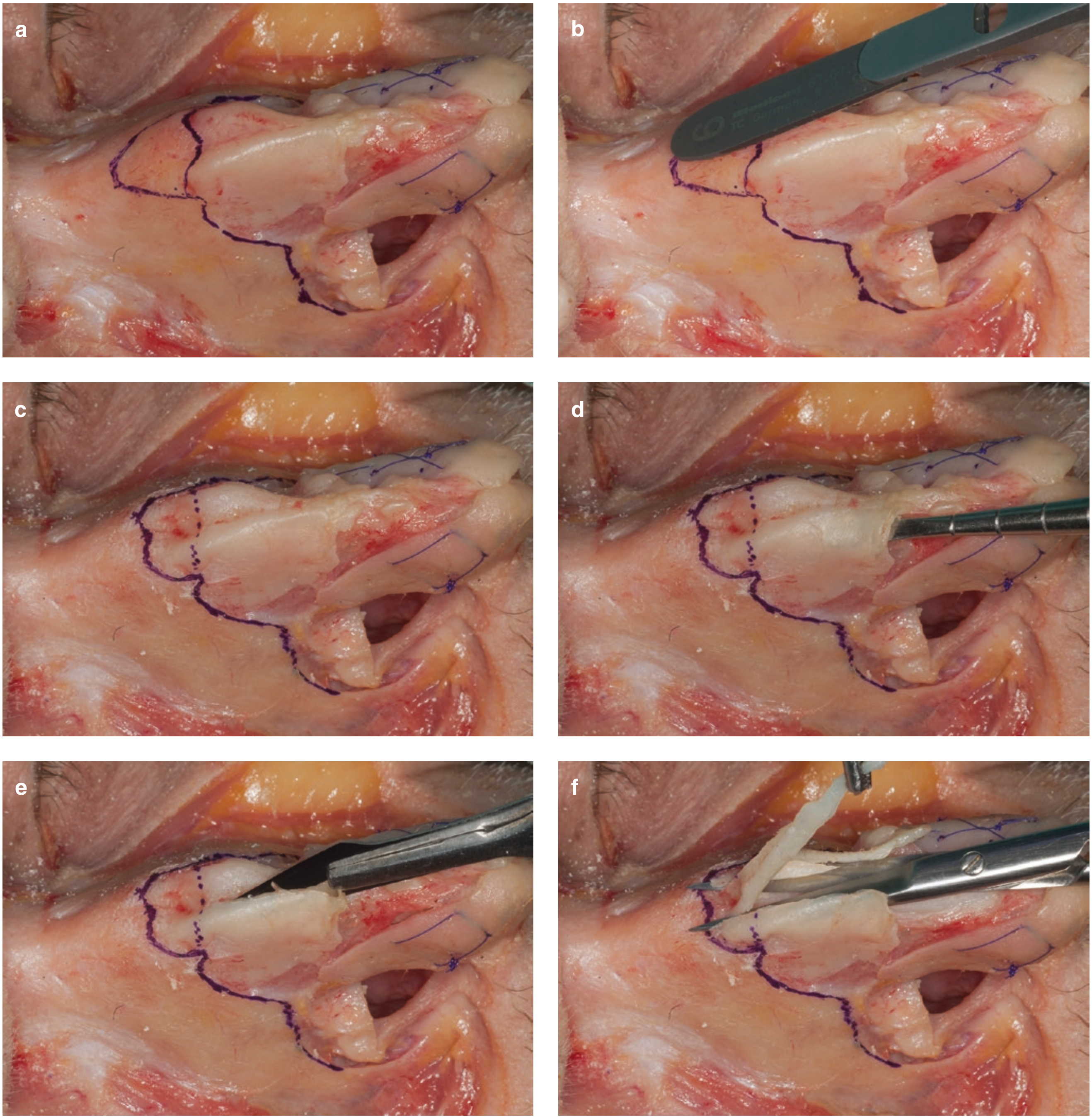


Fig. 3.25 (**a–f**) Component split-hump reduction sequence

Dorsal reduction sequence (Fig. 3.25): (1) Subperiosteal exposure of the bony pyramid; (2) removal of the bony cap using a rasp; (3) exposure of the intact cartilaginous vault cephalic to the keystone junction (*see dotted line* in Fig. 3.25c); (4) creation of extramucosal tunnels; (5) splitting off of the ULC using a broken-off #11 blade; and (6) lowering of the dorsal septum with scissors. (Note: The tip of the scissors extends onto the bone to prevent creation of a dorsal notch.)

OSTEOTOMIES—LATERAL OSTEOTOMIES

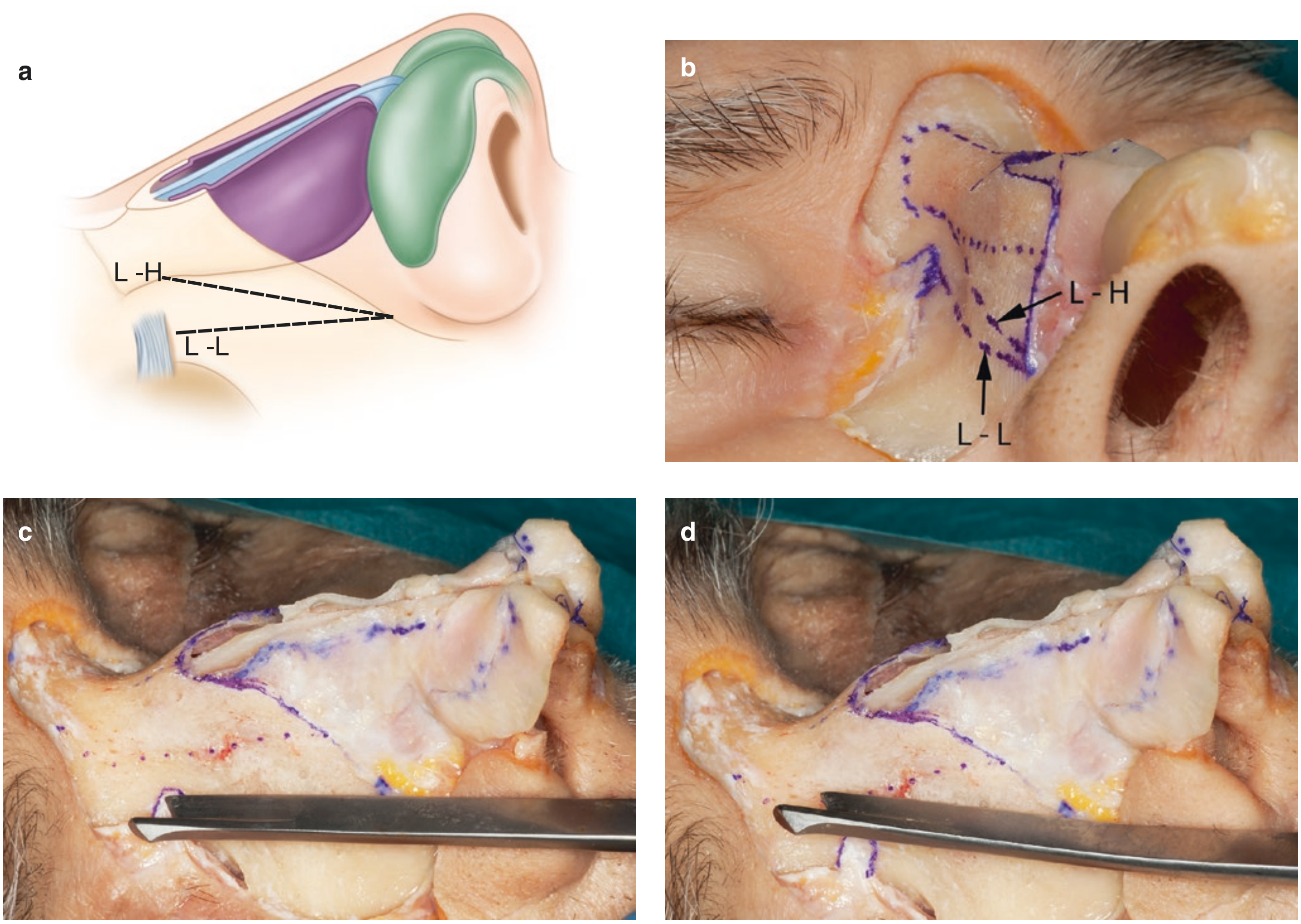


Fig. 3.26 (**a**, **b**) Low-to-high (L–H) and low-to-low (L–L) lateral osteotomies. (**c**) L–L osteotomy. (**d**) L–H osteotomy stays within the frontal process of the maxilla and ends at the nasal bone- frontal process of maxilla suture line

Since the time of Joseph (Joseph 1931), lateral osteotomies have been done to narrow the broad nose following hump reduction. Initially, they were performed with saws placed in the nasofacial groove and continued from the pyriform aperture to above the medial canthal ligament (MCL). Once the osteotomies were completed, digital pressure was used to move the bones medially. Aufricth added medial osteotomies to all his rhinoplasties (Millard 1996). Once both osteotomies were done, the nasal bones were "outfractured" from the medial followed by "infracturing" from the lateral to achieve complete movement of the lateral bony wall. Ultimately, surgeons switched to chisels and osteotomies, as they were less traumatic, and preferred infracturing only. Limited skin undermining was done to promote skin stability on the mobilized bones. Tardy and colleagues used 2-mm micro-osteotomies for medial oblique osteotomies followed by low lateral osteotomies (Becker et al. 1997). Sheen (1978) advanced the concept of the ***low-to-high osteotomy***, which begins low on the pyriform aperture and ascends across the frontal process of the maxilla, ending at the suture line of the nasal bone and the frontal process of the maxilla (Fig. 3.26). Narrowing of the nose and closure of the open roof is accomplished with a transverse greenstick fracture. In contrast, the ***low to low osteotomy*** remains within the frontal process of the maxilla and requires another osteotomy to pass from its cephalic termination into the open roof—either a previous medial oblique osteotomy coming down from the open roof, or a transverse osteotomy coming upward from the region of the MCL.

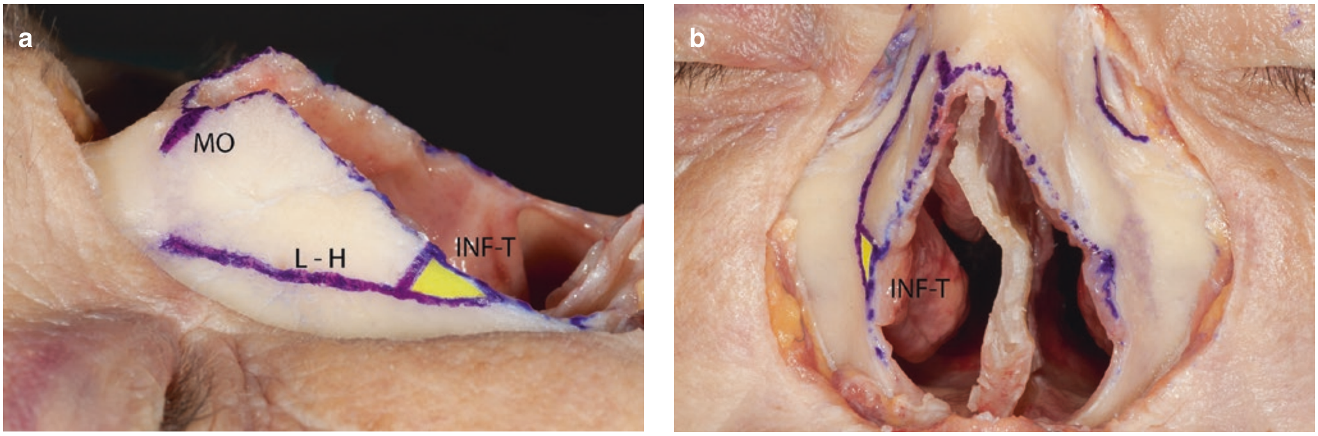


Fig. 3.27 (**a**–**b**) Preservation of Webster's triangle (*yellow*) with low-to-high (L–H) and medial oblique (MO) osteotomies. The bony cap and cartilaginous septum are removed to see the inferior turbinate (INF-T) on the opposite side

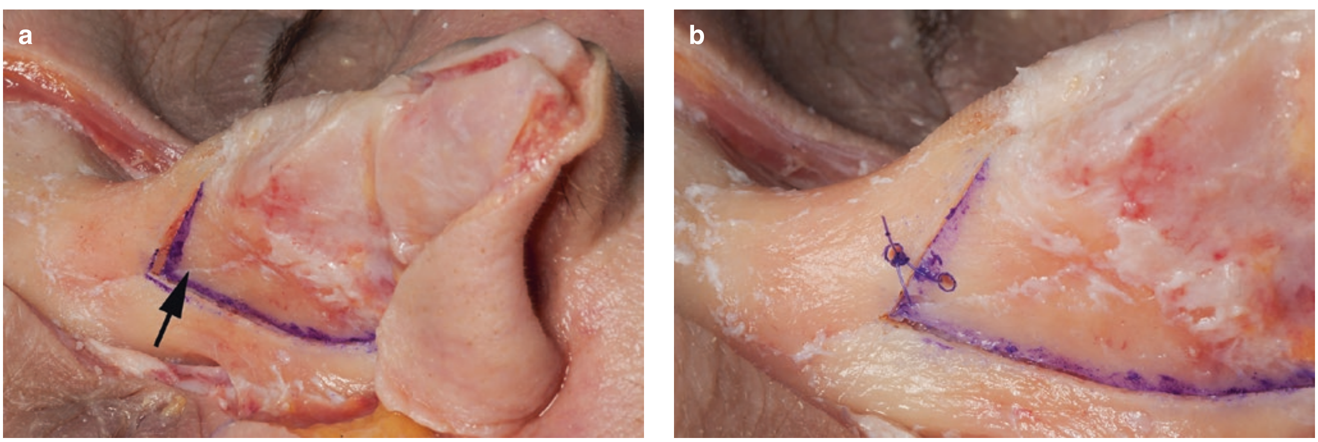


Fig. 3.28 (**a**) Lateral wall collapse following osteotomy. (**b**) Subsequent suture stabilization

The longitudinal extent and location of lateral osteotomies has changed dramatically from Joseph's original design. First, surgeons realized that there was rarely a need to go above the MCL, and doing so risked significant bony irregularities. In almost all cases, the bony vault is "narrow-waisted" at the level of the MCL and the bone above is fused solidly and is prone to visible rocker formation. Next, surgeons began to place the lateral osteotomy significantly more anterior, away from the nasofacial groove and the face of the maxilla. Also, the goal was no longer complete mobilization of the lateral nasal wall, but rather inward tilt and stabilization. In 1977, Webster et al. proposed that a triangle of bone be preserved at the pyriform aperture to maintain intact the airway below the level of the inferior turbinates (Fig. 3.27). He advocated use of a curved lateral osteotome placed more anteriorly and superiorly than previously done. This dictum led to the concept of a "high-low-high" lateral osteotomy. Guyuron (2012) agrees with the functional reduction in airway patency that can occur in cases where the head of the inferior turbinate extends beyond the pyriform aperture. In contrast, Gubisch (2017) does not feel the need to maintain a bony triangle routinely. As surgeons have become more aggressive in mobilizing the lateral nasal wall, a concomitant increase has occurred in the need to stabilize the bones in the new desired position. Thus, surgeons are increasingly placing drill holes through the bones and fixing them with sutures both laterally and dorsally (Fig. 3.28).

MEDIAL OSTEOTOMIES

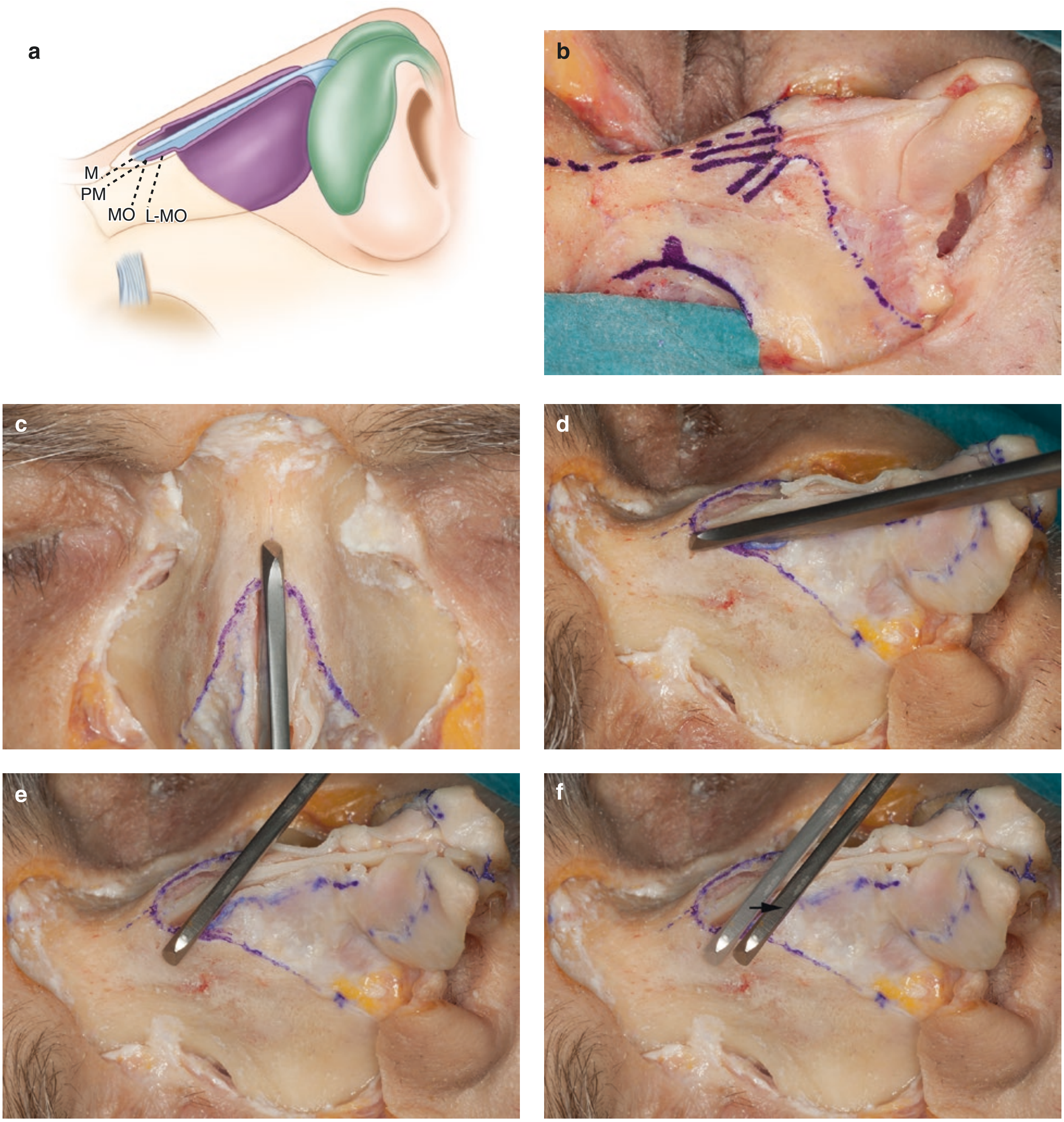


Fig. 3.29 (**a**, **b**) Medial osteotomy types. (**c**) Medial (M). (**d**) Paramedian (PM). (**e**) Medial oblique (MO). (**f**) Lateralized medial oblique (L–MO)

Osteotomies were done to narrow the open roof following a major hump reduction. Initially, they consisted of a lateral osteotomy placed in the nasofacial groove. Subsequently, a *true paramedial* medial osteotomy, which paralleled the septum, was added to ensure total mobilization of the lateral wall (Fig. 3.29). The true medial osteotomy, when extended cephalically, could lead to fragmentation in the fused radix bone, however, resulting in a "rocker formation." A *paramedian osteotomy* is placed at the high point of the open roof, often 2–3 mm from the septum. Currently, most surgeons prefer a ***medial oblique osteotomy***, which passes downward toward the MCL, usually at angle of 15–25° from the midline. Gruber et al. (2007) prefer a *lateralized medial oblique osteotomy*, the most caudal osteotomy shown in Fig. 3.29f.

INTERMEDIATE OSTEOTOMIES

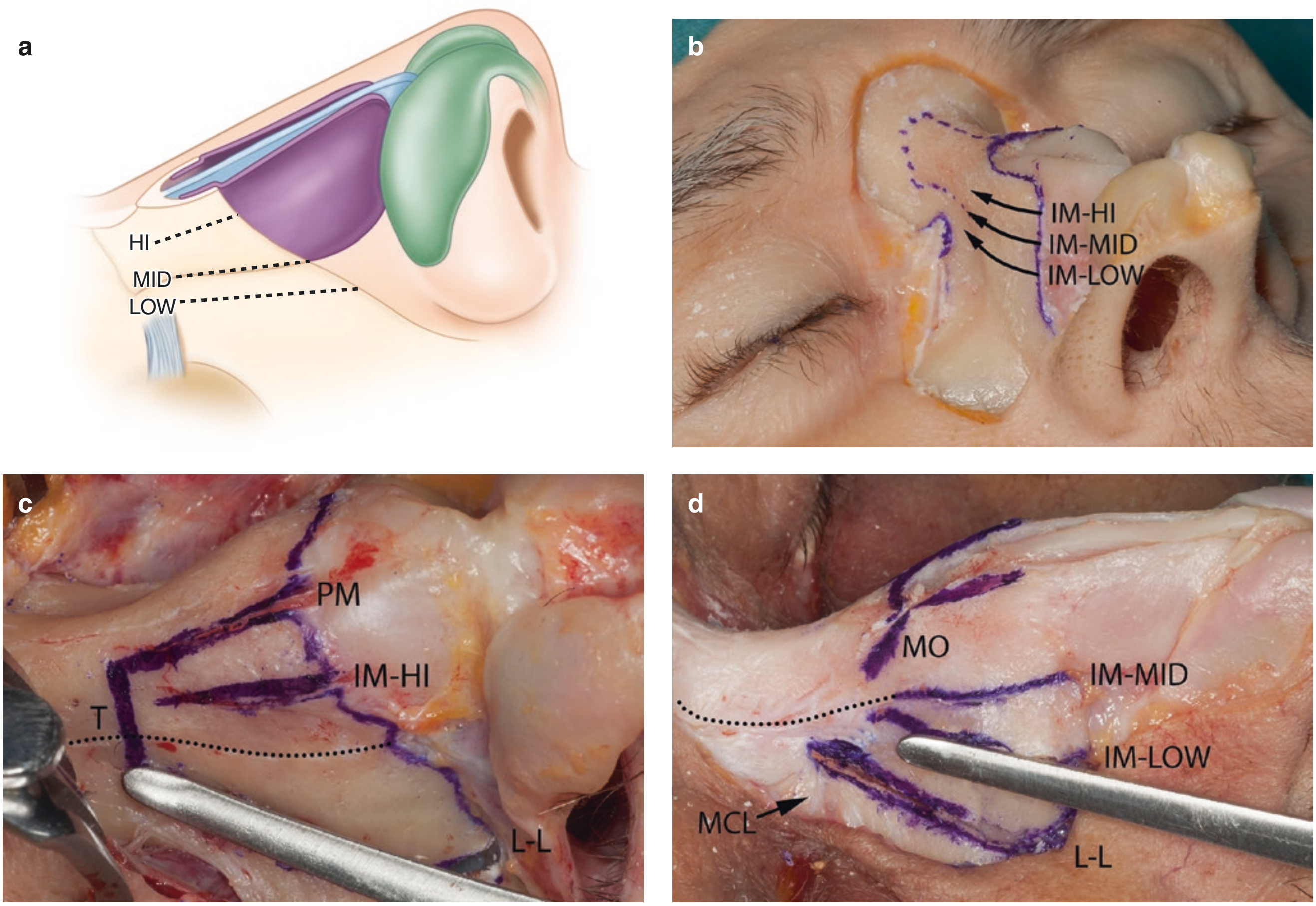


Fig. 3.30 (**a**, **b**) Intermediate osteotomy types: high (IM-HI); mid-level (IM-MID); and low (IM-LOW). (**c**) IM-HI osteotomy. (**d**) IM-LOW and L-L osteotomies. Dotted line represents the nasomaxillary suture line. L–L—low-to-low

Intermediate osteotomies began as a variation of Parkes' "double level osteotomy" (Parkes et al. 1977). This technique was devised to correct an intrinsically convex lateral nasal bony wall at the suture line of the nasal bone and the frontal process of the maxilla. A 2-mm osteotome passes from caudal to cephalic along the suture, thus breaking the intrinsic convexity and allowing the more anterior nasal bone to be verticalized and medialized—*i.e.*, a ***mid-level intermediate osteotomy*** (Fig. 3.30). Then, a low-to-low lateral osteotomy was done to narrow the base bony width (x–x point) in the inferior half of the lateral bony wall. This approach has proven extremely effective. Subsequently, Ghanaatpisheh et al. (2015) adopted the combination of a medial oblique and a high intermediate osteotomy to effectively narrow the dorsal line without recourse to lateral osteotomies. The ***high intermediate osteotomy*** passes totally within the nasal bone itself. In contrast, the senior author adopted a ***low-intermediate osteotomy*** to allow shortening of long lateral walls in patients with significantly asymmetric noses (Kosins et al. 2016). Essentially, the height of the short bony wall is transferred to the long wall and the desired site for the low-intermediate osteotomy is drawn. Then a low-to-low osteotomy is drawn in the nasofacial groove, which is often 6–8 mm lower.

COMPLETE OSTEOTOMIES

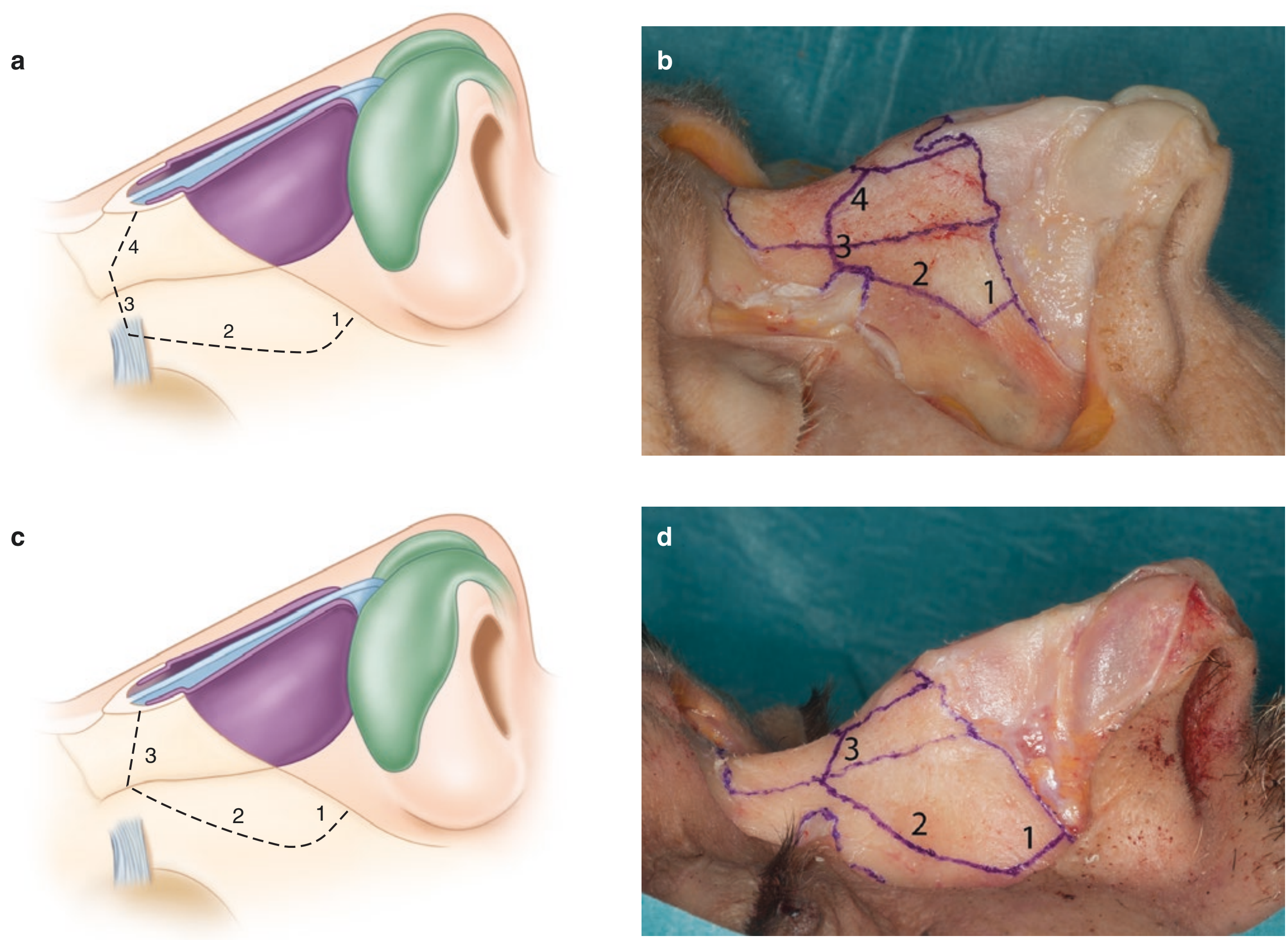


Fig. 3.31 Complete osteotomy using piezoelectric lateral osteotomy pattern. (**a**, **b**) U-shape pattern. (**c**, **d**) V-shape pattern

As currently used in rhinoplasty surgery, piezoelectric instrumentation (PEI) has many distinct advantages compared with handheld and power-assisted instruments (Gerbault et al. 2016). There is minimal (if any) damage to the surrounding soft tissues and no significant risk of osteonecrosis. Extensive exposure allows the surgeon to more accurately analyze and surgically correct deformities of the osseocartilaginous vault. Indication, execution, and evaluation of osteotomies is no longer done blindly, so far greater precision is possible. Bony cap removal can be done atraumatically, which minimizes damage to the underlying cartilaginous vault. PEI is used to remove the lateral edges of the bony vault, with optional extension onto the lateral side wall. This extension has two powerful effects: First, it allows the cephalic dorsal lines following hump reduction to be determined by cartilage rather than by the bony lateral wall. It also allows shaping of the cephalic cartilaginous vault with sutures, thereby reducing the need for medial oblique osteotomies to modify or narrow the dorsal bony vault. Lateral bony wall asymmetry can be directly addressed by ultrasonic rhinosculpture rather than by merely breaking the bone. All types of osteotomies can be done more precisely without risk of radiating fracture lines that occur with osteotomies. Osteotomies and rasping can be done on brittle or thin bones, as well as on mobilized lateral bony walls, without risk of disruption. Complete osteotomies can be done with stability, as the underlying periosteum and mucosa are not damaged, which is very difficult with conventional techniques. The extended dissection allows the surgeon to easily stabilize bones if they're unstable, by drilling holes in the bones and suturing them to the central dorsum.

COMPLETE OSTEOTOMIES

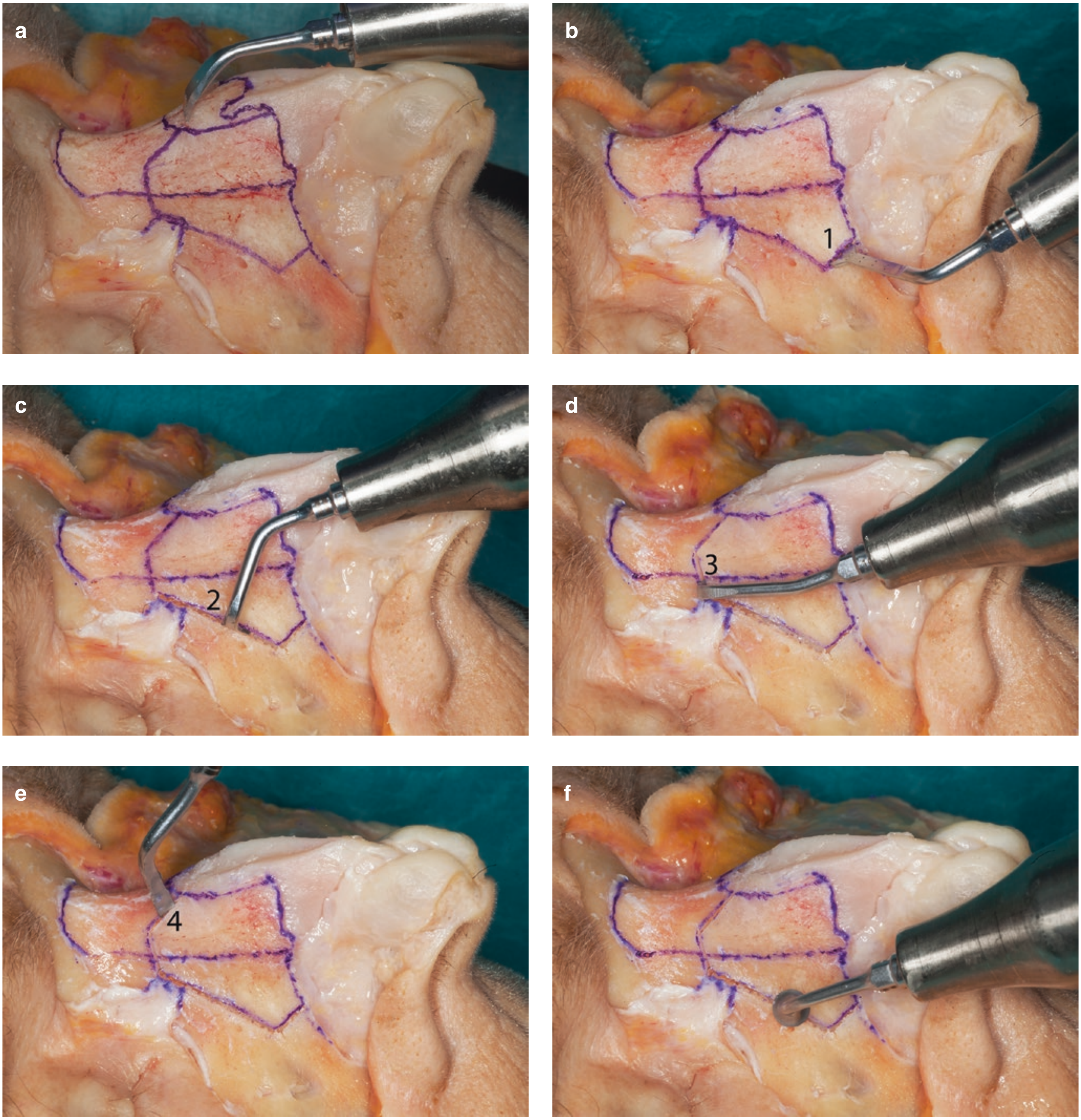


Fig. 3.32 The most commonly used operative sequence for complete osteotomy, using piezoelectric saws. (**a**) Bony cap removal. Revealing the intact cartilaginous vault. (**b**) Cut #1 is downward from the pyriform aperture to the nasofacial groove, thereby preserving Webster's triangle. (**c**) Cut #2 is a lateral osteotomy in the nasofacial groove. (**d**) Cut #3 is a transverse osteotomy at the level of the MCL. (**e**) Cut #4 is a medial oblique coming down from the new bony dorsum. (**f**) Smoothing of the bony edges

Figure 3.31 illustrates two shapes of complete osteotomies as performed using PEI, and Fig. 3.32 shows the most commonly used operative sequence. Note that one has the option of leaving a slight bony bridge between the medial oblique and transverse osteotomies, or making it continuous and thereby achieving complete mobilization. Stability is maintained by the intact underlying periosteum and mucosa.

ADVANCED OSTEOTOMIES

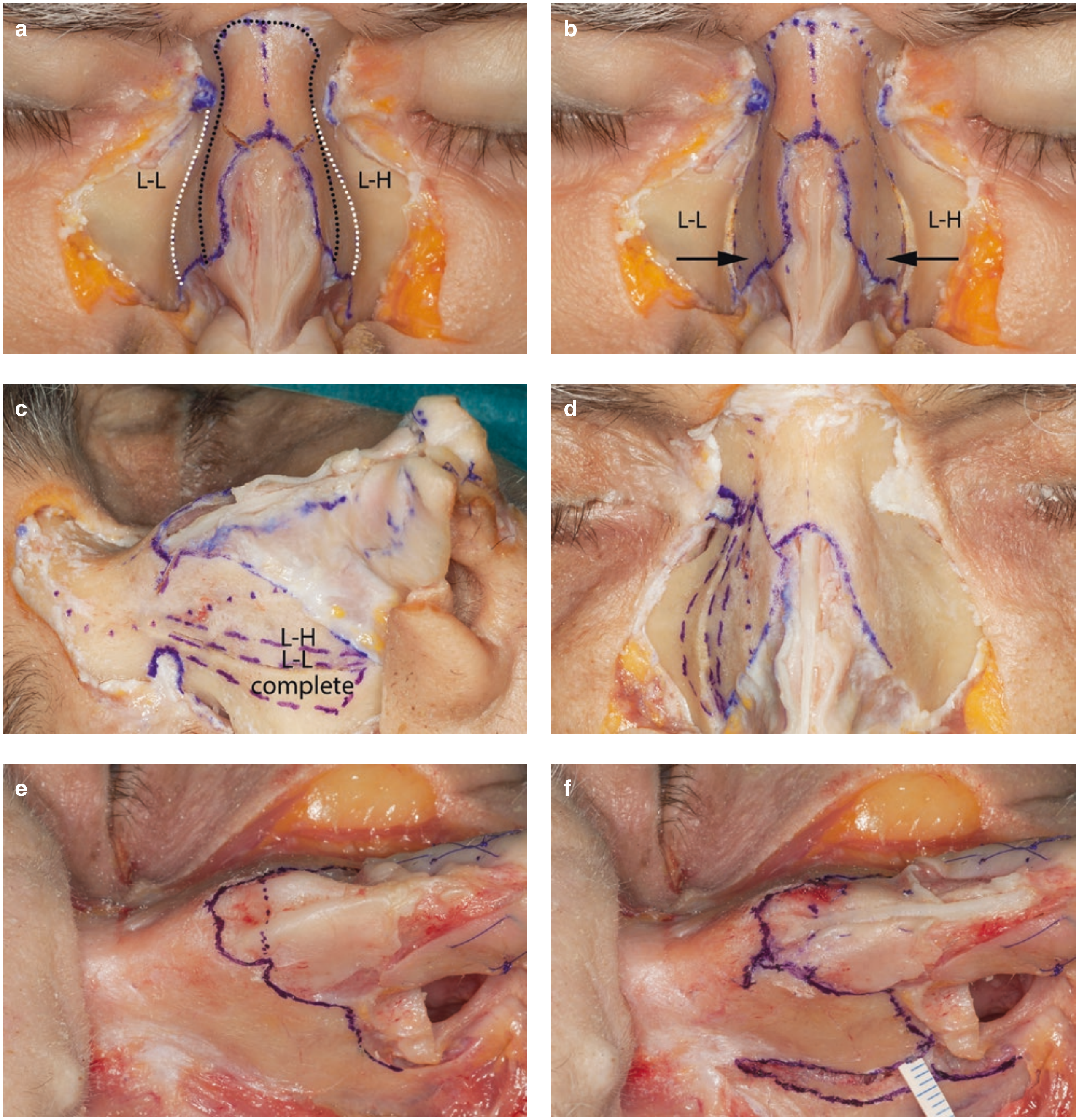


Fig. 3.33 (**a**) L–L *versus* L–H osteotomy. *White dotted line* indicates level of osteotomies, L-L on the right and L-H on the left. (**b**) *Arrows* indicate medial transverse movement after lateral osteotomy and medial oblique osteotomies. (**c**, **d**) Contrast in location between lateral osteotomies: L–H, L–L, and piezoelectric lateral, which is placed in the nasofacial groove. Note the remaining convexity in the lateral wall between the L–L osteotomy and nasofacial groove. (**e**, **f**) Dramatic medial movement of 4mm from a lateral and medial oblique osteotomy

Our understanding of the bony vault and the effect of osteotomies has changed dramatically since the adoption of *extensive exposure* to facilitate PEI osteotomies under direct vision. There is a close correlation between cadaver and clinical findings. The distance between a true L–L osteotomy and one placed in the nasofacial groove is quite significant (Fig. 3.33). Equally dramatic is the amount of base width narrowing that occurs following a *complete lateral osteotomy* only. Note: almost 4 mm of transverse lateral movement occurs from a lateral osteotomy only—no associated transverse or medial oblique osteotomy.

ADVANCED OSTEOTOMIES

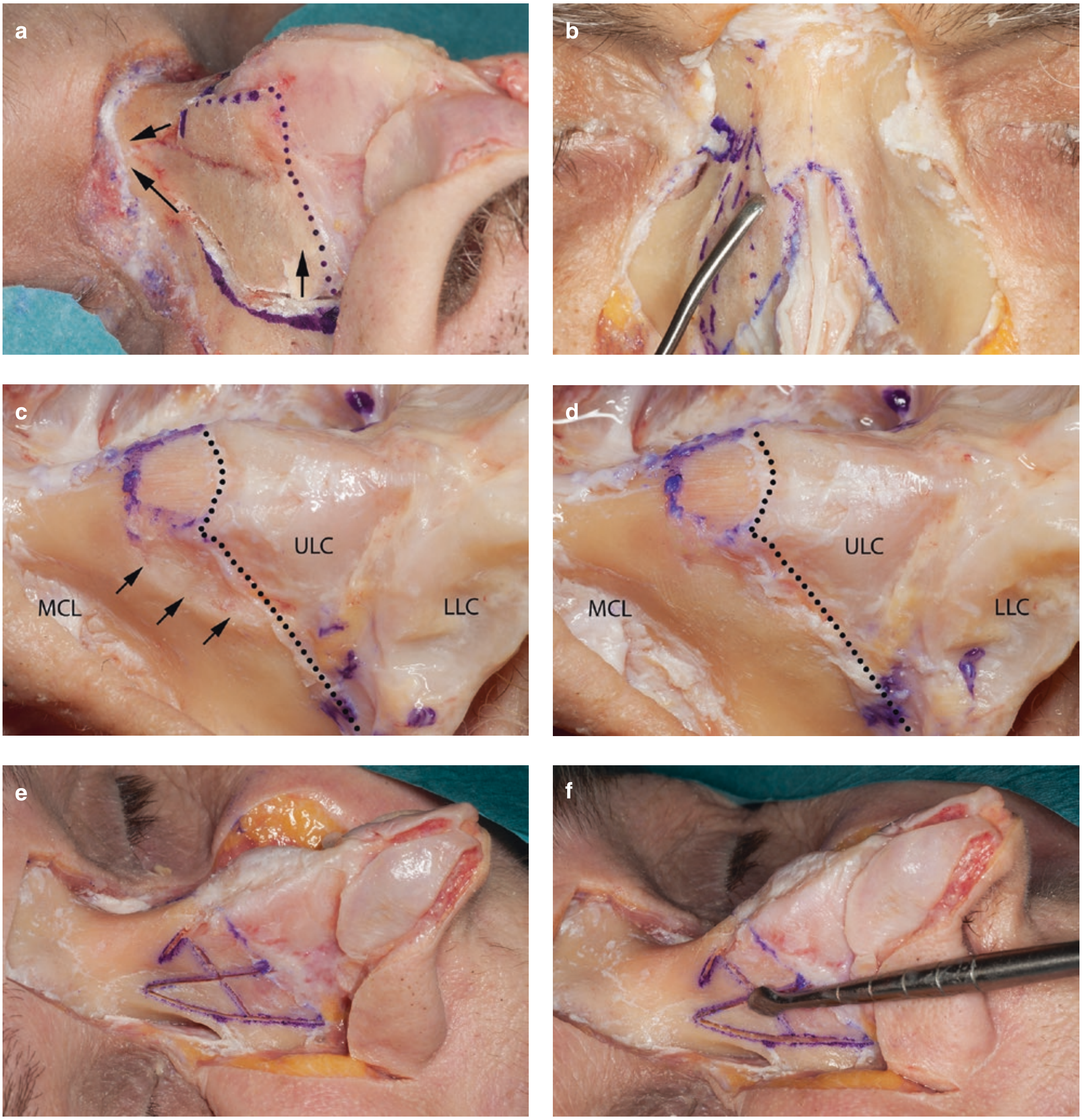


Fig. 3.34 (**a**) *Arrows* indicate undesirable radiating fracture lines produced with an osteotome in three typical location. (**b**) Irregularities of dorsum and over-narrowing of lateral wall following use of an ostetome. (**c**, **d**) Reshaping the lateral nasal wall for convexities and irregularities using PEI rhinosculpture. (**e**, **f**) Convexity treatment in the lateral nasal wall

The inherent disadvantage of osteotomies is the occurrence of radiating fracture lines and/or irregularities (Fig. 3.34a, b). These can be avoided by using PEI saw inserts. Importantly, PEI rasps allow the surgeon to smooth bony edges even on mobilized bones. In addition, the same maneuvers can be done to shape the bony vault, a technique termed "rhinosculpture" (Fig. 3.34c, d). The advantage of this approach is that shaping and narrowing of the bony vault can be done without recourse to osteotomies. In very convex bones, one can do a checkerboard, "criss-cross" pattern of cuts, or a combination of vertical and transverse cuts at the site of convexity (Fig. 3.34e, f).

MIDDLE VAULT RECONSTRUCTION—SPREADER GRAFTS

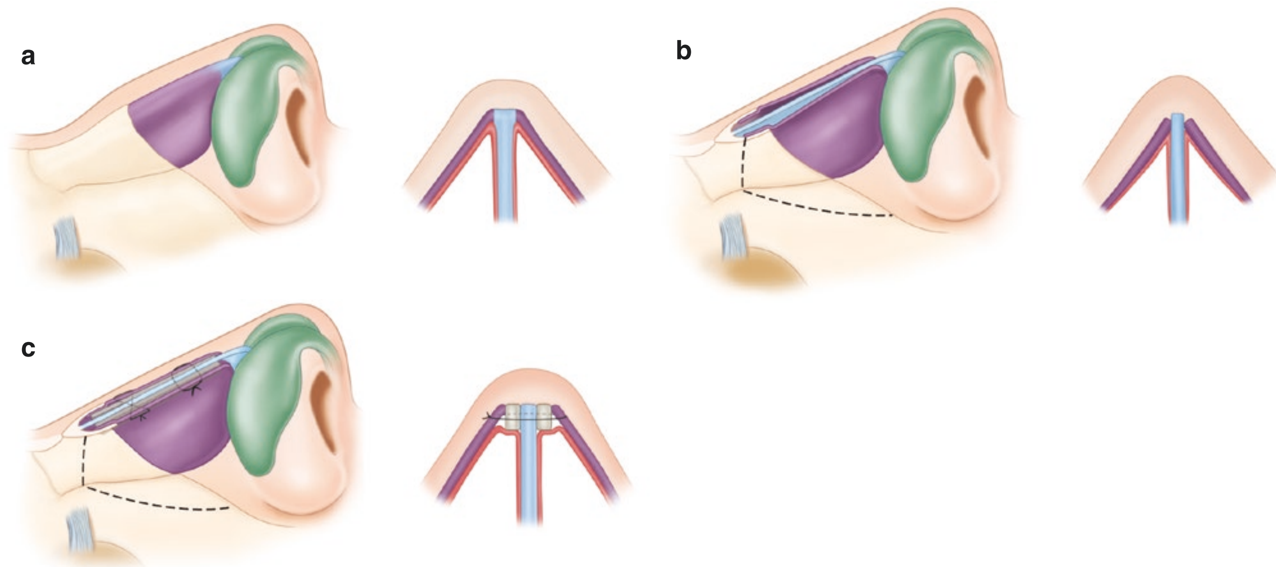


Fig. 3.35 (**a**–**c**) Spreader grafts

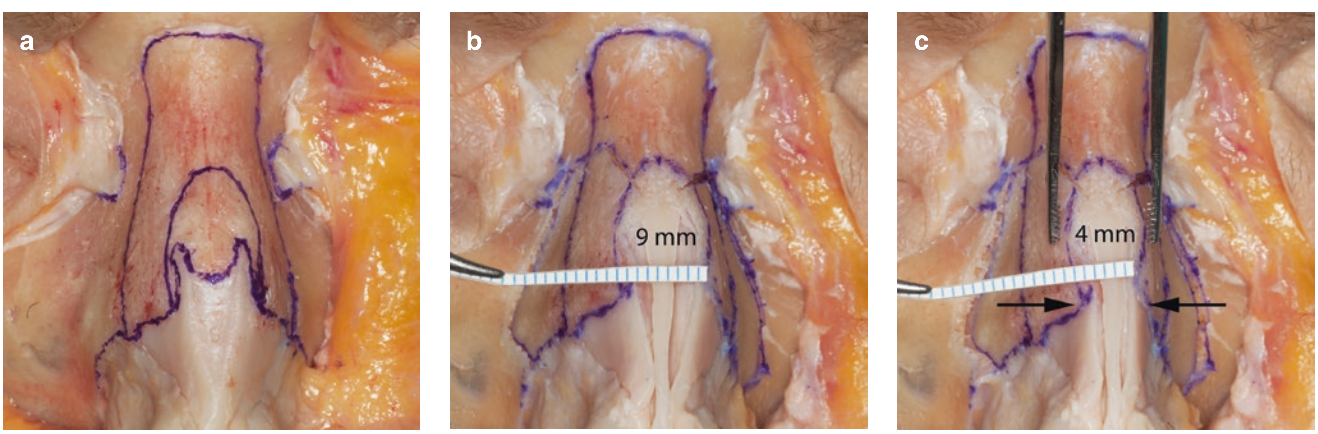


Fig. 3.36 (**a**–**c**) Over-narrowing of the nasal dorsum from 9 to 4 mm occurs following dorsal reduction and ostetotomies which can be preevented with spreader flaps

Spreader grafts are a functional and aesthetic necessity for middle vault reconstruction. Following resection of the dorsal hump, the superior portion of the septum is converted from a broad "T", which distracts the ULCs, to a narrow "I", which allows the ULCs to collapse inward (Fig. 3.35). Spreader grafts reestablish the broad "T" of the septum, thereby achieving two critical factors: functionally, the internal nasal valve angle is opened, and aesthetically, the dorsal lines are supported, thereby preventing a collapsed, inverted-V deformity (Fig. 3.36) (Sheen 1984). Thickness varies from the usual 1.5 mm up to 4 mm, depending upon narrowness and asymmetry. The height is 2–3 mm to facilitate suturing, and the length is 15–25 mm, depending on availability. A true "pocket" as Sheen originally envisioned is not possible caudally, but is very desirable cephalically under the bony vault. The grafts are inserted one at a time, making sure to have a smooth dorsum. They are held in place with two #25 needles placed percutaneously. One pierces all five layers: the ULC, then the spreader graft, the septum, spreader graft, and opposite ULC. Frequently, the caudal end is sutured first with 5-0 PDS, often incorporating just the spreader grafts and the septum (three layers), whereas the cephalic suture incorporates the ULCs as well (five layers). Suturing avoids accidental disruption or dorsal displacement of the spreader grafts.

MIDDLE VAULT RECONSTRUCTION—SPREADER GRAFTS

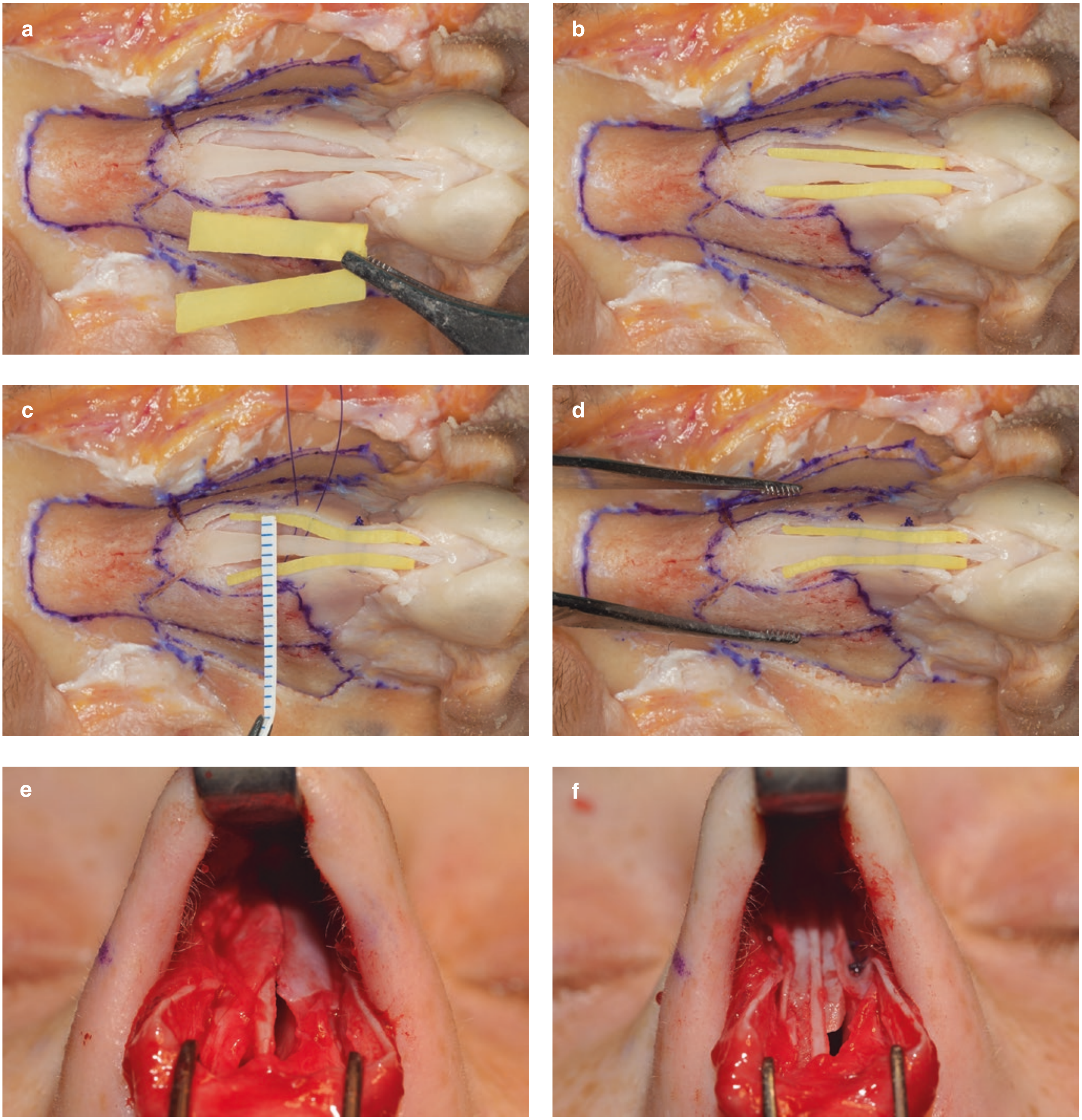


Fig. 3.37 (**a–d**) Spreader grafts. (**e**, **f**) Spreader grafts used in an abnormally narrow dorsum, where spreader flaps are contraindicated

With the introduction of spreader flaps, the use of spreader grafts has decreased significantly, but they remain the preferred technique in many cases: preexisting narrow midvault (Fig. 3.37e, f); significant dorsal asymmetry; limited dorsal reduction (0–3 mm); most secondary procedures. Spreader grafts are extremely versatile and allow the surgeon to achieve the desired dorsal width and correct asymmetry while avoiding mid-vault collapse. Every surgeon must be comfortable doing spreader grafts because they are absolutely essential.

SPREADER FLAPS

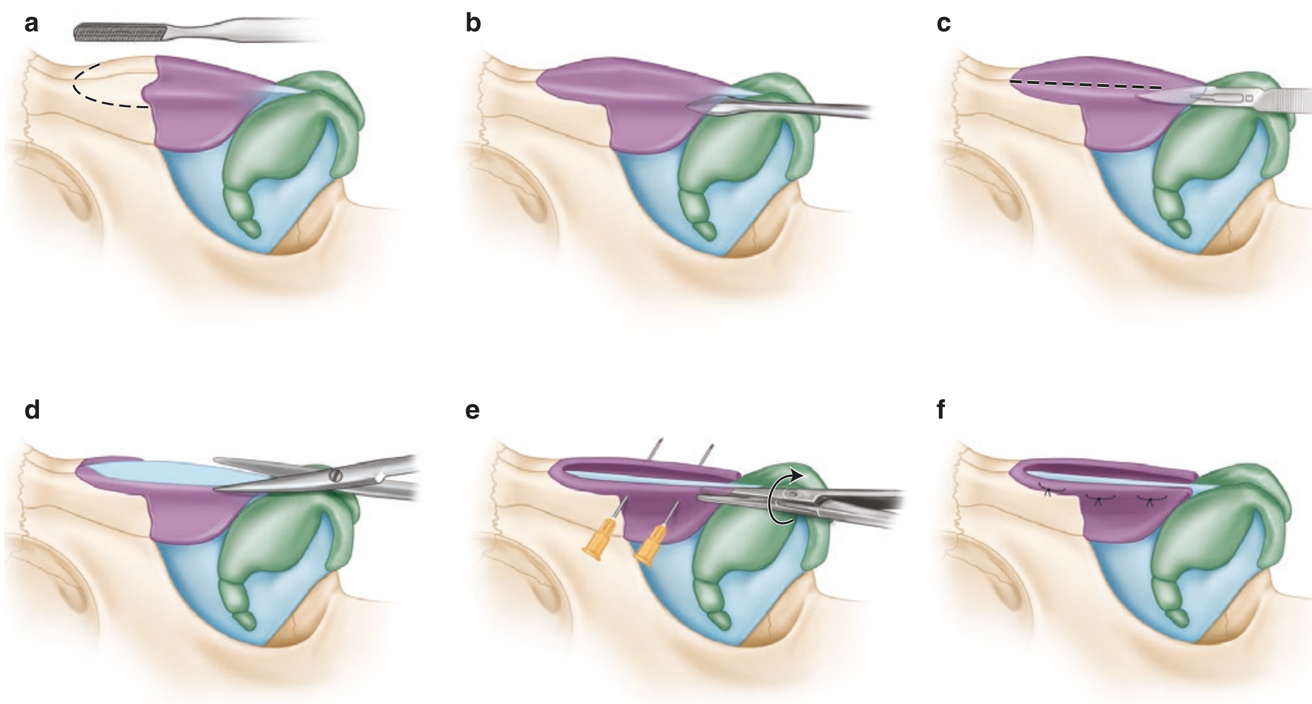


Fig. 3.38 (**a**–**f**) Spreader flap technique

Simplistically, **spreader flaps** are turned-in portions of the detached ULC, which are folded inward and sutured to the septum to create outward distraction on the ULC. Unlike the spreader graft, with its single originator (Sheen 1978), the spreader flap had multiple developers, including Gruber and Perkins (2010), Cerkes (2011), and Oneal and Berkowitz (1998). At this time, there are two methods—partial length and full length. Gruber and others advocate doing the spreader flap prior to the dorsal reduction. Extramucosal tunnels are made from the ASA up to and under the bony vault. The ULCs are then detached from the septum. The upper medial portion of each ULC is detached from the bone using an elevator. Then the caudal end of the ULC is pulled out to length, and the cartilage folded over. Two 5-0 PDS sutures are inserted to maintain the fold. Then the exposed dorsal septum is removed using a scalpel, followed by bony hump removal with an osteotome.

Why don't we like this method? The primary reason is that it wastes cartilage and we strongly prefer reducing the bone first. Our preferred technique (Figs. 3.38 and 3.39) is as follows: (1) Expose the cartilaginous vault more laterally if spreader flaps are to be done; (2) remove the bony cap, using a rasp to expose the intact cartilaginous vault; (3) create extramucosal tunnels; (4) detach the ULC full-length; (5) lower the dorsal septum full-length using scissors with the tips resting on the bony vault; (6) fold the ULC over to create the desired width and fix temporarily to the septum with straight #25 needles; and (7) suture both ULCs to the septum using 4-0 PDS from inside the bony vault to the keystone area, and taper downward to the ASA.

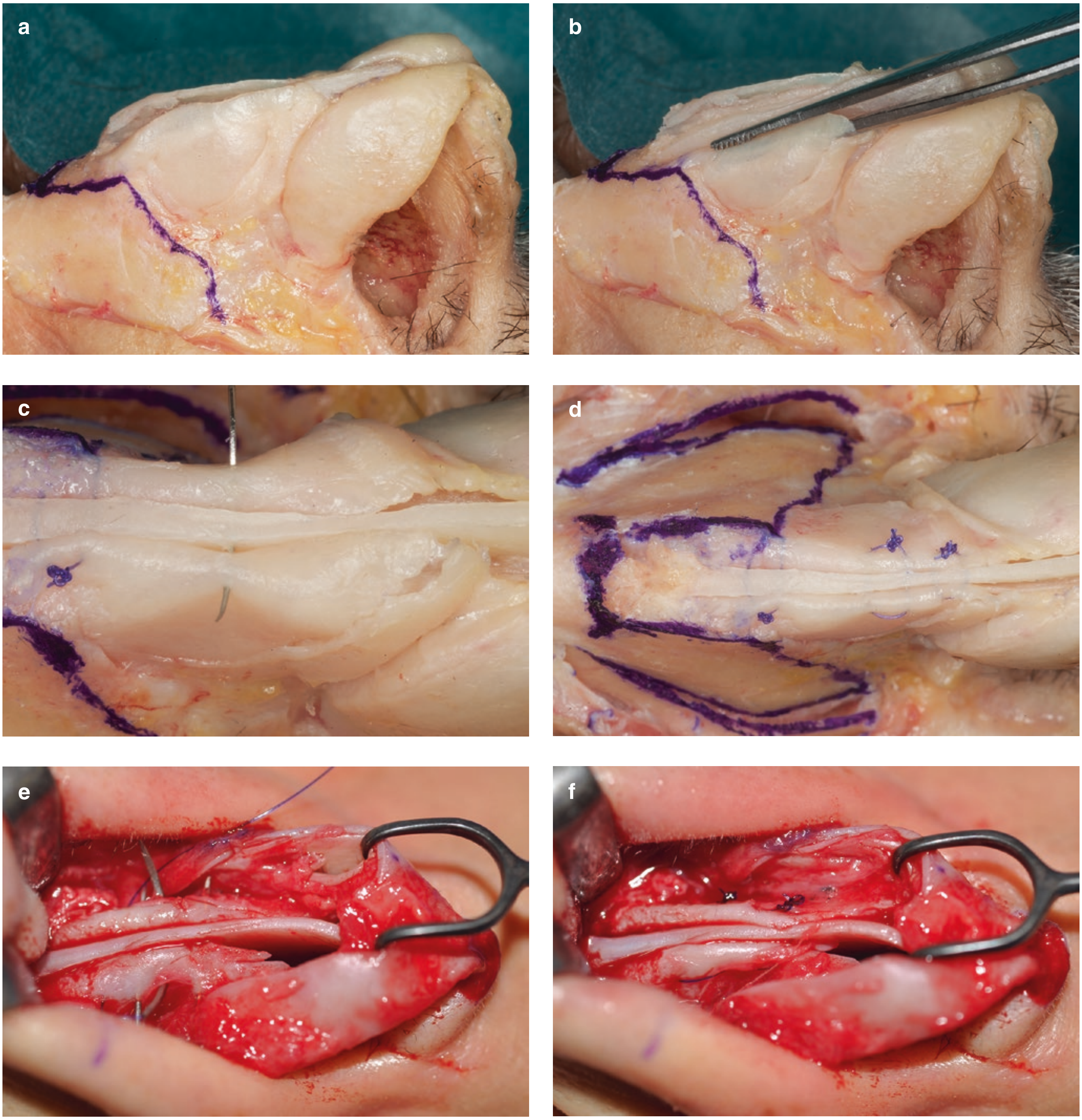


Fig. 3.39 Spreader flap (**a–d**) anatomically and (**e–f**) clinically

There are multiple variations in performing spreader flaps. If the ULC is quite rigid or too wide, then one can either score the ULC or make partial-length cuts. In major reductions (>8 mm), it may be necessary to fold and suture each ULC separately prior to dorsal reduction, to improve visualization of the anterior dorsal septum. In certain cases, there will be insufficient ULC caudally, and small spreader grafts must be added caudally. In asymmetric noses, we often use a combination of spreader flaps and spreader grafts. Ultimately, we preserve the ULC as possible spreader flaps in every primary case. There is no need to resect the ULC to lower the dorsum.

DORSAL MODIFICATION—DORSAL REDUCTION (CASE STUDY)

Analysis: A 17-year-old student felt that her nose was too big, the profile too prominent, and the tip too droopy. A major dorsal reduction would be necessary. The smiling view demonstrates that the patient has a tension nose and a very distinct anterior septal prominence (ASP), as opposed to an anterior septal angle (ASA).

Operative Technique (Fig. 3.40):

1) Small chin implant. Open approach. Septal exposure.
2) Dorsal reduction (B 1.5, C 7 mm at ASP). Caudal septal resection 4 mm at caudal septal prominence and 2 mm at ASA.
3) Resection of anterior nasal spine (ASA).
4) Medial oblique and L-L osteotomies. Bilateral spreader grafts.
5) Insertion of columellar strut. Tip sutures: CS, DC, ID, DE. Tip refinement graft (folded shield).

Commentary: A major change in the profile was necessary to achieve the desired result (Fig. 3.41). The reduction occurred in two steps—reduction of the anterior septal line and then shortening of the caudal septum. The patient's tension nose on profile demonstrated a distinct ASP, which required a major resection. In addition, the nose was simply too long and the columellar inclination was 90°. The obtuseness of the columella-labial angle and the very short upper lip led to resection of the anterior nasal spine.

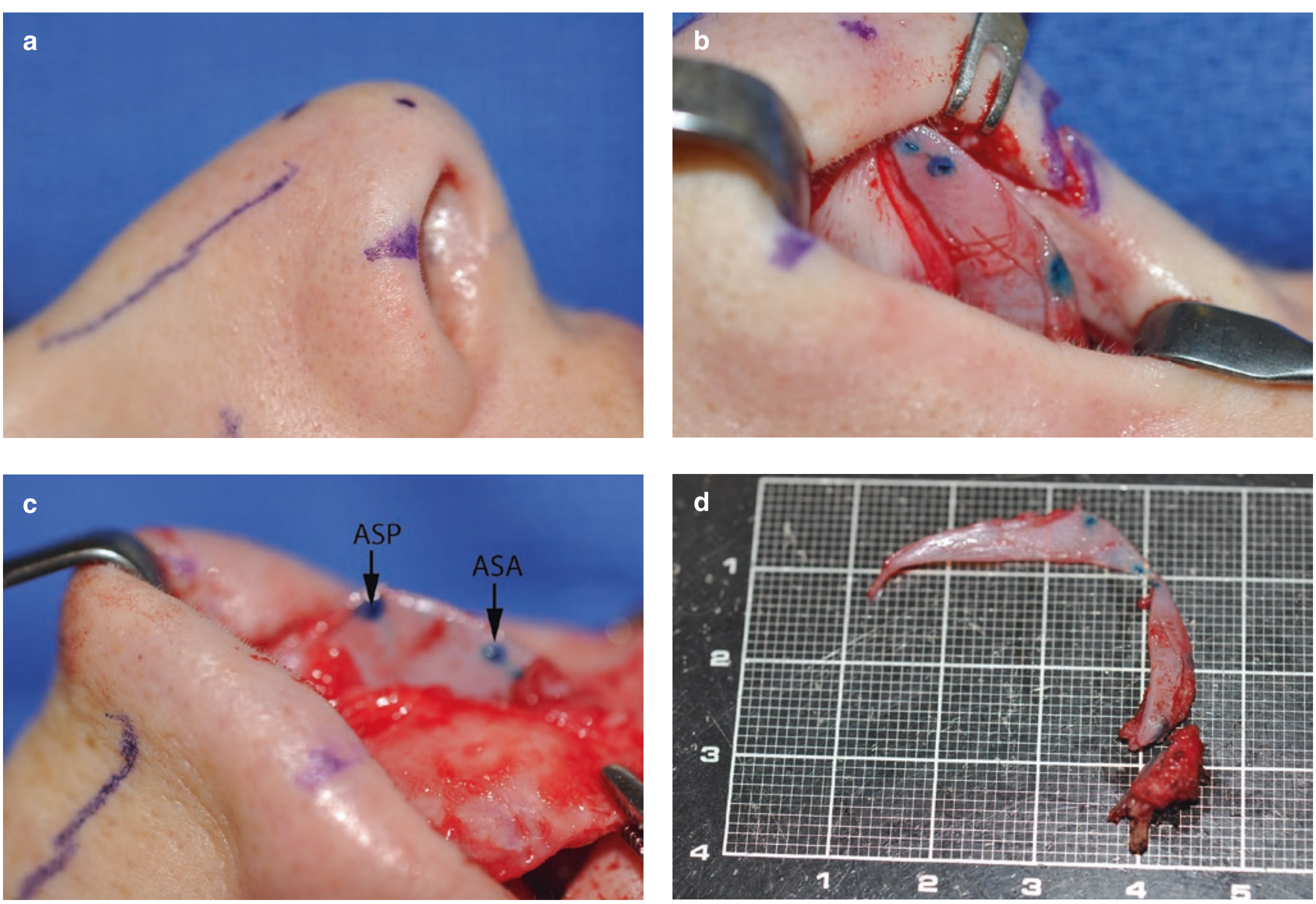


Fig. 3.40 (**a–d**) Dorsal reduction and shortening of the caudal septum and anterior nasal spine. *ASA* anterior septal angle. *ASP* anterior septal prominence

DORSAL MODIFICATION—DORSAL REDUCTION (CASE STUDY)

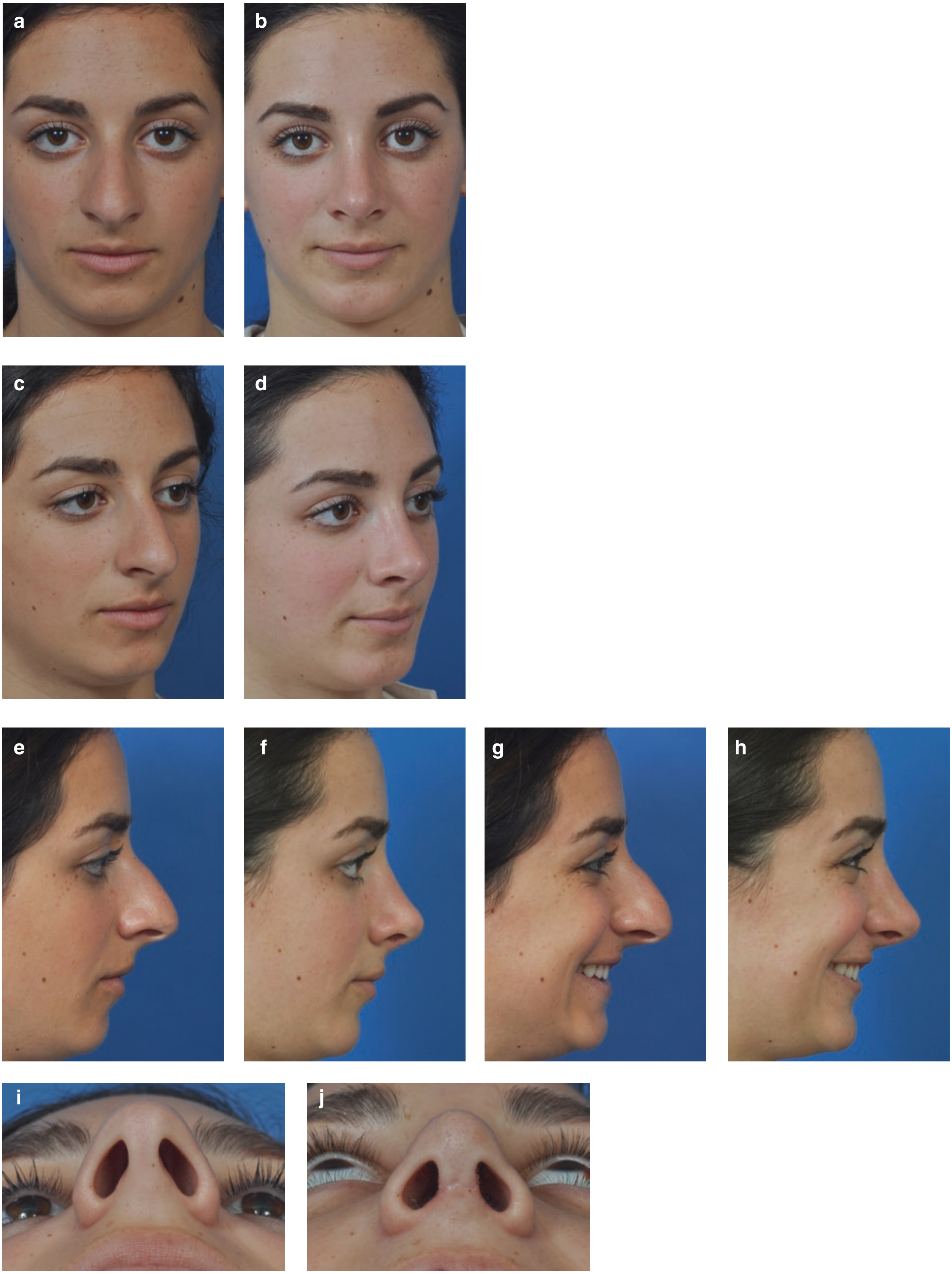


Fig. 3.41 (**a–j**) Patient in case study, before (*left*) and after (*right*) dorsal reduction

DORSAL REDUCTION WITH PIEZOELECTRIC INSTRUMENTATION (CASE STUDY)

Analysis: A 28-year-old woman requested a rhinoplasty, as she considered her nose too big, the dorsum too convex, and the tip too droopy. The patient was 5′10″ tall and had played basketball. She denied nasal trauma, and the significant asymmetry was considered developmental rather than traumatic. The goal was to eliminate the negatives without making a major change to the nose.

Operative Technique:

1) Fascial harvest. Open approach. Narrow lateral crura, 2-mm cephalic resection.
2) Removal of bony cap with piezoelectric rasp, followed by ultrasonic rhinosculpting (URS) laterally (Fig. 3.42a, b).
3) Anterior septal reduction of 5 mm at ASA and 2 mm at keystone. Caudal septal resection: 3 mm.
4) Septal body resection and caudal septal relocation R to L. Unilateral R spreader grafts.
5) Closure of open roof with spreader flaps extending high into the bony vault (Fig. 3.42c, d). No osteotomies.
6) Insertion of a columellar strut. Tip sutures: CS, CTS, DE. Fascia placed over tip.
7) Radix–dorsal fascia graft. 3-mm nostril sill excision plus alar rim graft.

Commentary: The goal was to make a significant change in the look of the nose while preserving its structural integrity. The piezoelectric rasping and URS allowed contouring of the dorsum and obviated the need for osteotomies. The balanced approach limited the amount of reduction (Fig. 3.43).

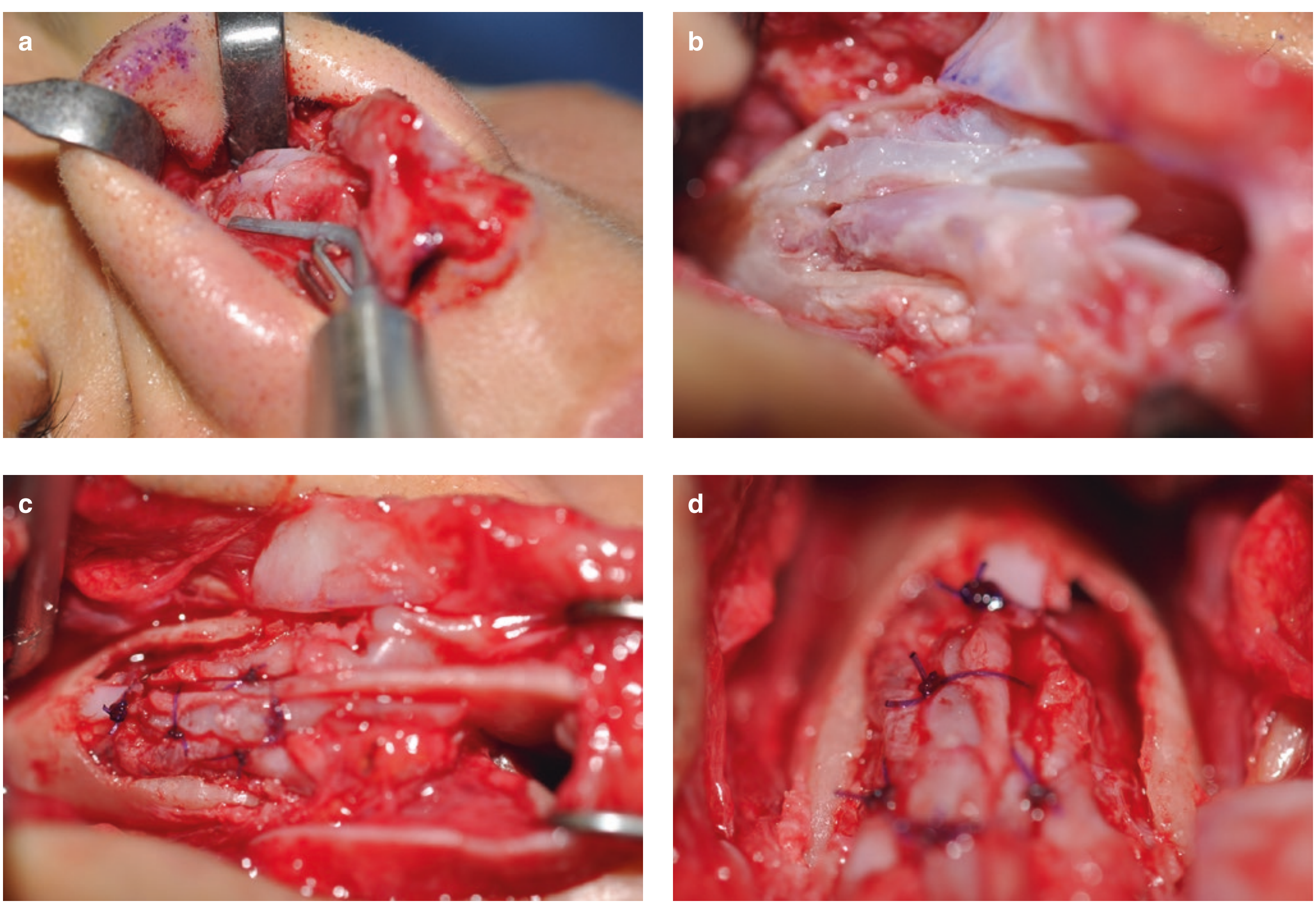


Fig. 3.42 (**a–d**) Dorsal reduction using a piezoelectric device. Note: preservation and utilization of ULC above the keystone area for spreader flaps to close the open roof for 10mm above the original keystone junction

DORSAL REDUCTION WITH PIEZOELECTRIC INSTRUMENTATION (CASE STUDY)

Fig. 3.43 (**a–h**) Patient in case study, before (*left*) and after (*right*) dorsal reduction

DORSAL AUGMENTATION (CASE STUDY)

Analysis: A 44-year-old woman of Filipino descent requested a rhinoplasty. As is typical, she wanted a very stylized nose, and brought in pictures of Asian actresses who obviously had silicone implants. Essentially, the procedure would involve the triad of dorsal augmentation, increased tip projection, and greater tip definition. Because of the patient's severe dorsal flatness, a rib graft was planned (Fig. 3.44).

Operative Technique:

1) Harvest of cartilaginous portions of eighth and nineth ribs. Fascia harvest.
2) Open approach in subdermal plane, followed by maximum soft tissue envelope defatting.
3) Tip split harvest of septum. Placement of septal extension graft between extended spreader grafts.
4) Insertion of a solid rib "base graft" (32 × 4 mm) followed by a DC-F graft (32 × 8.5 mm), resulting in 12.5 mm of dorsal augmentation.
5) Advancement of alar cartilages onto septal extension graft. Add-on of lateral extender grafts.
6) 1.5 cc of diced cartilage to each parapyriform area.

Commentary: Every area of the nose was augmented, from glabella to dorsum to tip to nasal base (Fig. 3.45). Conceptually, one is trying to replicate the effect of a silicone implant without the associated risks. The solid rib "base graft" serves as a platform foundation for the DC-F graft. It ensures that the base is unified with the dorsum. Preoperative nostril asymmetry persisted; the columellar was lengthened from 5 to 11 mm, which changed the axis of the nostrils and brought the nostril sills outward. The DC graft to the parapyriform corrected the paranasal depressions.

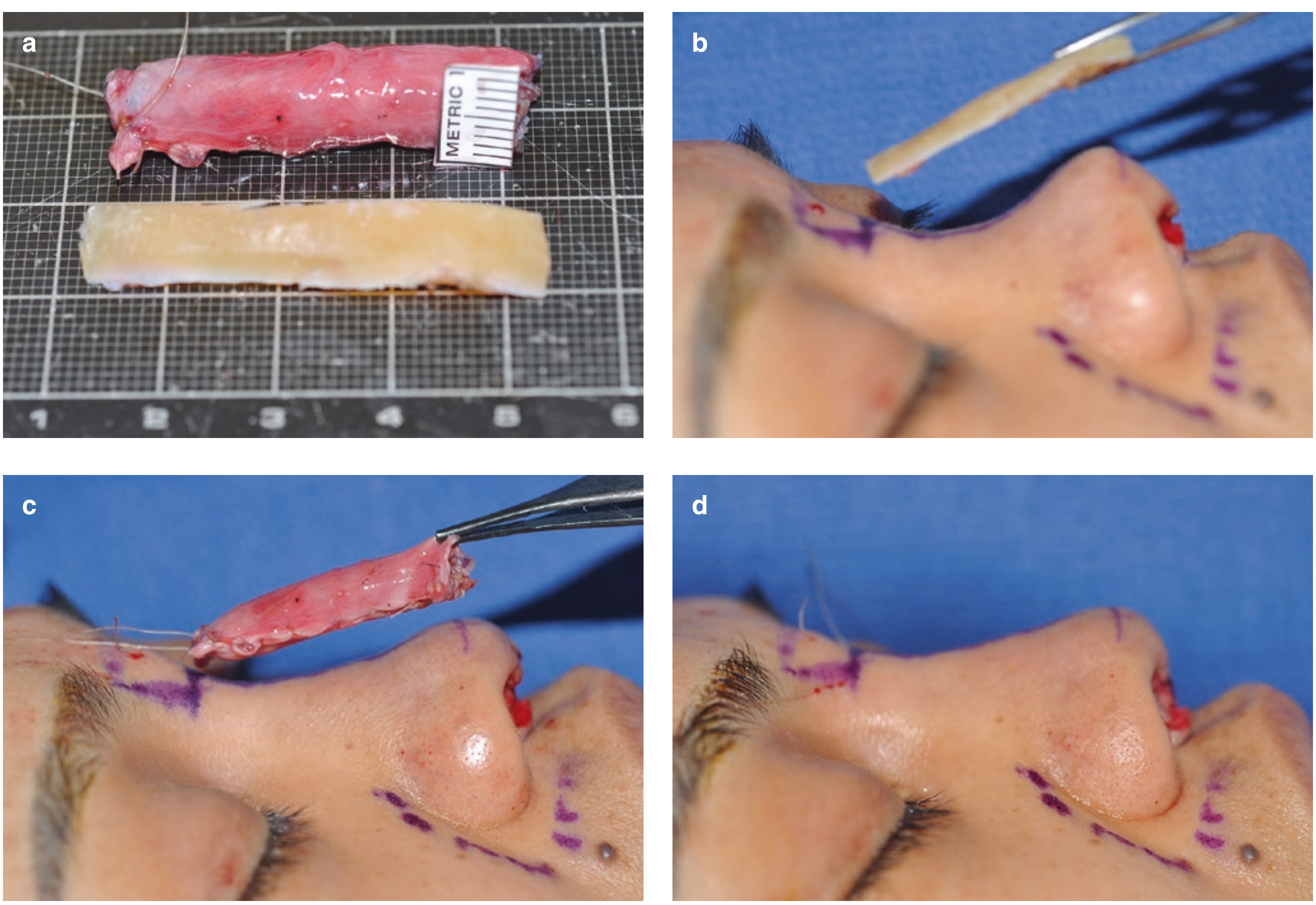


Fig. 3.44 (**a–d**) Dorsal augmentation

DORSAL AUGMENTATION (CASE STUDY)

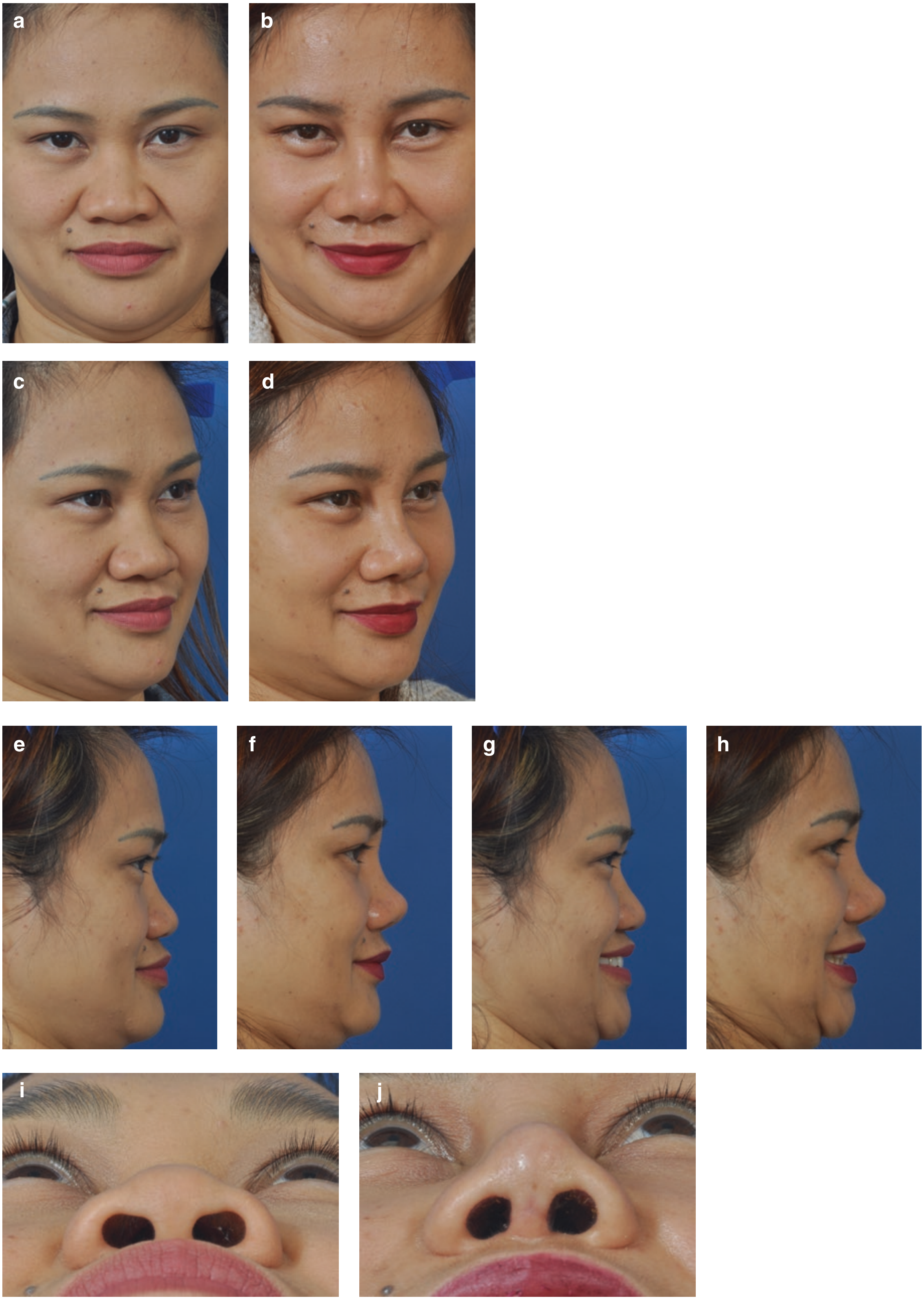


Fig. 3.45 (**a–j**) Patient in case study, before (*left*) and after (*right*) dorsal augmentation

NARROWING A WIDE NOSE

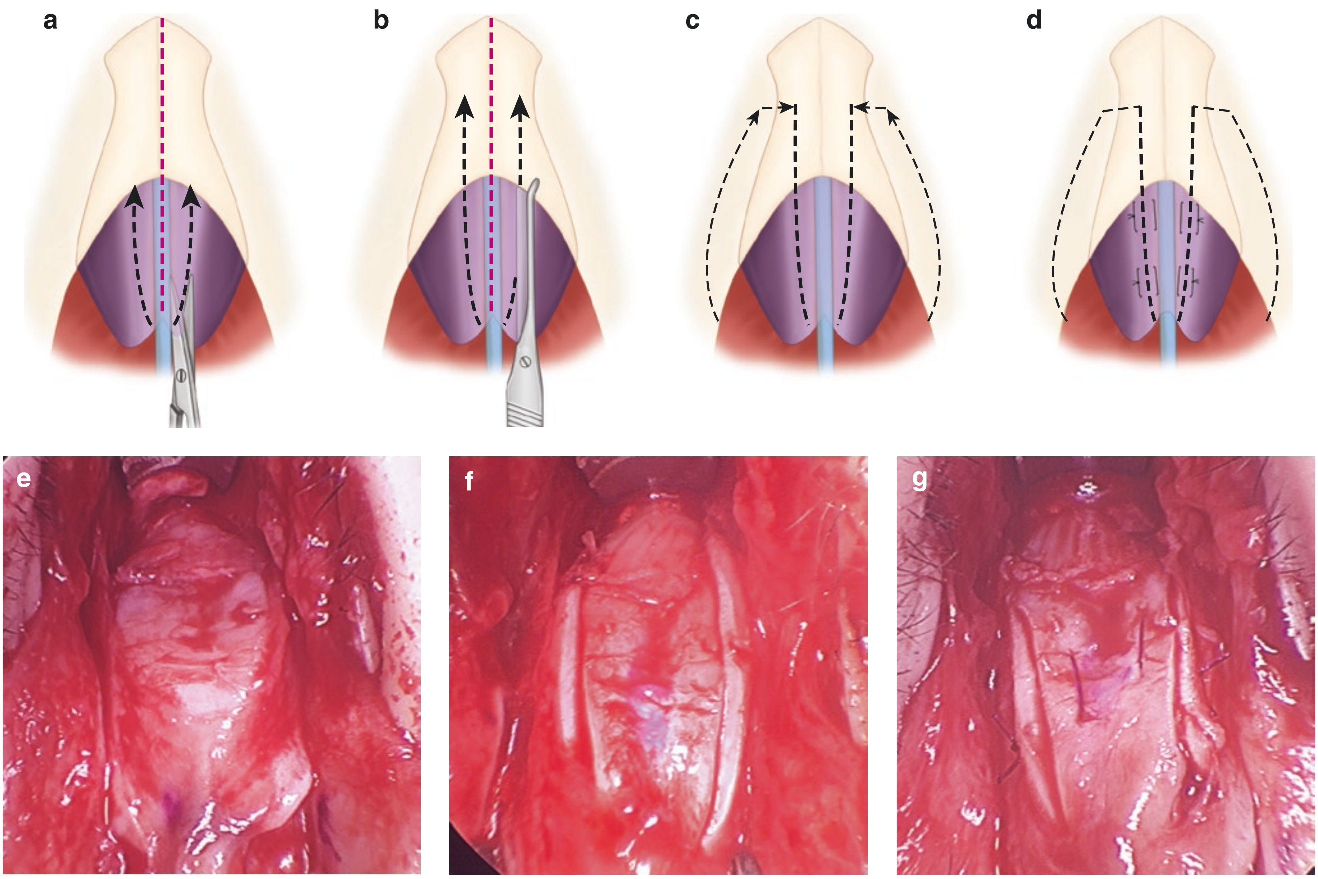


Fig. 3.46 (**a**–**g**) Narrowing the wide dorsum without removal of bony dorsum

For major width deformities—especially those with a normal dorsal height—we have devised the following procedure (Fig. 3.46):

1) The dorsum is exposed through an open approach.
2) The midline is marked.
3) The ideal dorsal width is marked on the osseocartilaginous vault (5–8 mm).
4) Paramedian cuts are made along the cartilaginous vault up to the keystone area.
5) These cuts are extended through the bone as paramedian osteotomies, using a straight guarded osteotome.
6) Lateral osteotomies are done, usually transverse and low-to-low osteotomies.
7) After the infractures, excessive height of the ULCs is excised (often 3–6 mm).
8) The ULCs are sutured adjacent to or underneath the T-shaped septum.

There is no need to excise bone in order to bring the bone inward and under the new, narrower dorsum.

CORRECTION OF A CROOKED NOSE

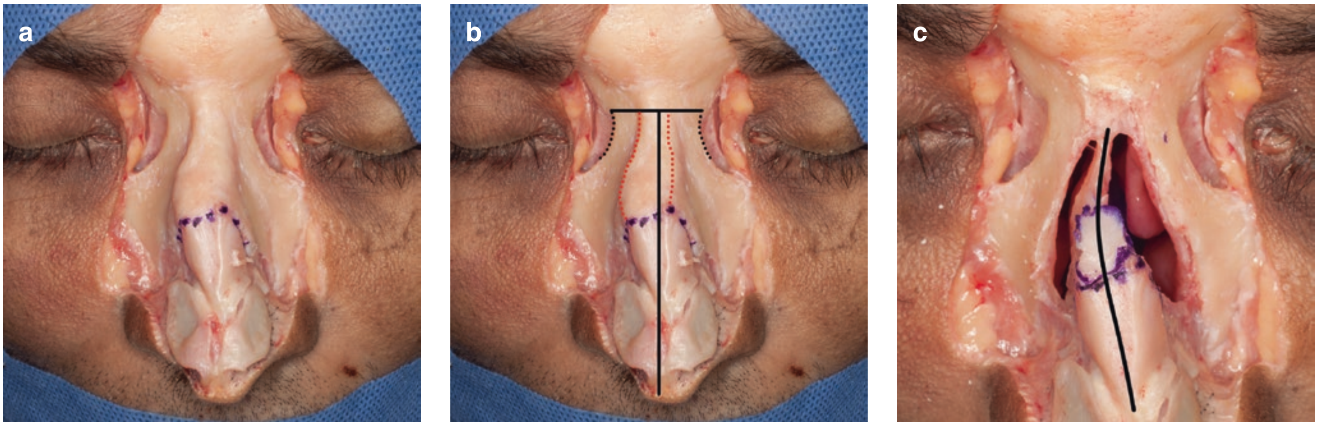


Fig. 3.47 (**a–c**) S-deviation of the bony and cartilaginous vaults as well as the septum

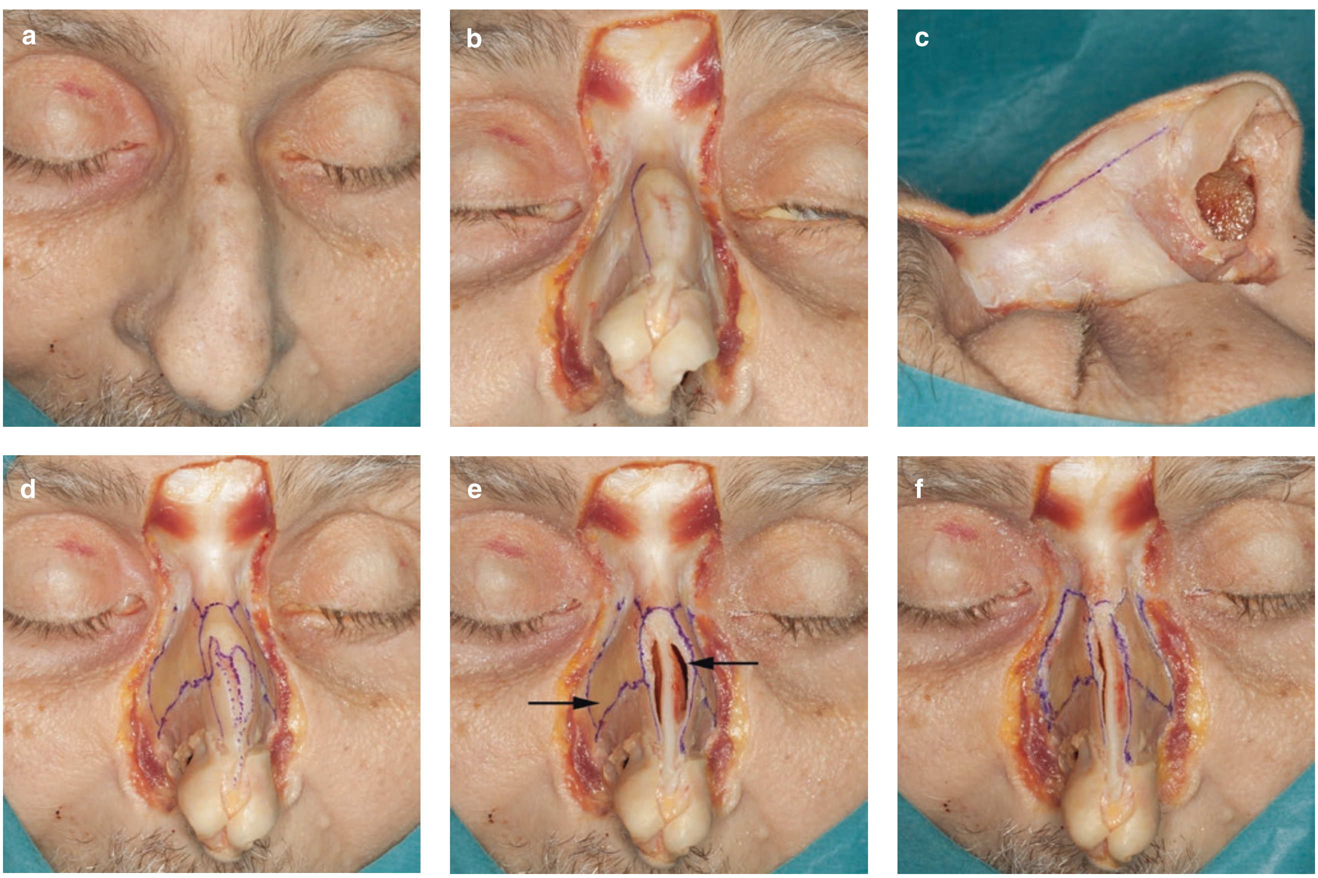


Fig. 3.48 (**a–f**) Crooked nose osteotomy sequence

Figures 3.47 and 3.48 illustrate the complexity of the correction of an *asymmetric developmental deviated nose (ADDN)* (Kosins et al. 2016). In Fig. 3.47, the right lateral nasal wall is deviated outward and is intrinsically convex, while the left bony wall is deviated inward and is intrinsically concave. Correction would require medial oblique osteotomies and a midlevel osteotomy on the right, with inward movement of the bony wall. On the left, the entire wall needs to be moved outward using a low-to-low osteotomy and a long spreader graft inserted into the bony vault. Distally, a doorstop spreader graft would be added to further widen the cartilage vault on the left. Alar asymmetry would be improved by a turn-over flap on the right.

WIDE NOSE (CASE STUDY)

Analysis: A 22-year-old hairdresser requested a major change in her nose; she did not like any aspect of it. Surprisingly, it was the "family nose" seen on photographs of her brother and sister. On analysis, there were three major challenges. First, the nose was extremely wide, with very convex lateral bony walls. Second, the nasofrontal angle was blunted. Third, the tip was flat, underprojecting, and lacked definition.

Operative Technique:

1) Open approach revealed a bilateral congenital gap in the middle crura, explaining the flat tip.
2) Dorsal exposure was followed by direct resection of the radix and glabellar muscles.
3) Septal exposure and harvest through a right unilateral transfixion incision.
4) Narrowing of the nasal dorsum using parallel paramedian incisions and osteotomies (Fig. 3.49).
5) Narrowing of the bony vault, with midlevel intermediate, transverse, and low-to-low osteotomies.
6) Insertion of a major columellar-septal strut with repair of the congenital gaps. Add-on tip refinement graft.

Commentary: Dorsal narrowing was done without either dorsal reduction or bone excision. In this case, a total of eight osteotomies were done: bilateral paramedian, midlevel intermediate, transverse, and low-to-low. Certainly, the wide nose has been significantly narrowed (Fig. 3.50), but a "balanced approach" was critical, with reduction of the muscle mass in the radix and achieving major tip support with a columellar-septal strut. No dorsal reduction was done, nor was any bone excised from the dorsum.

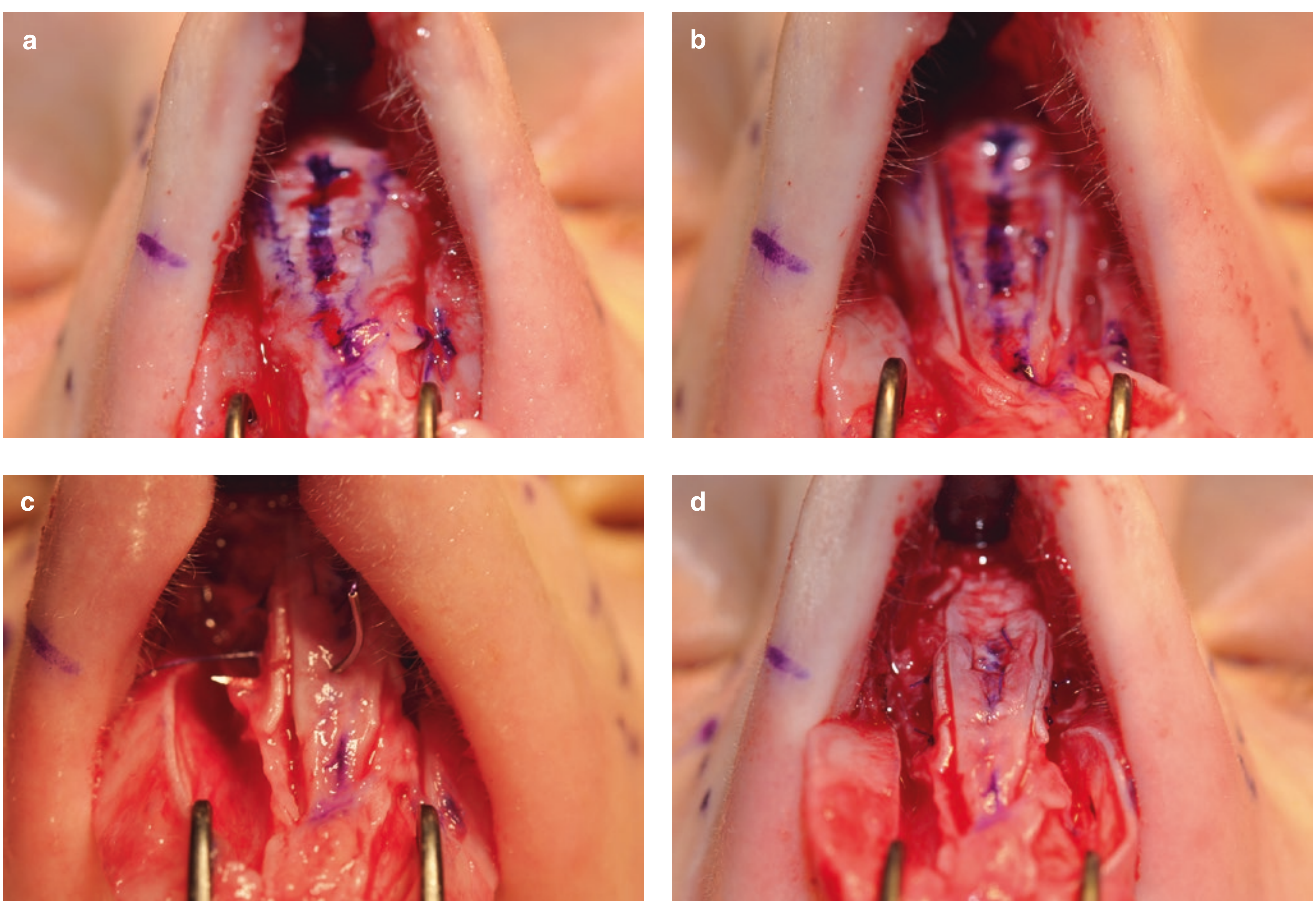


Fig. 3.49 (**a–d**) Dorsal modification and narrowing from 14 to 6mm done asymmetrically and without bony vault excision

WIDE NOSE (CASE STUDY)

Fig. 3.50 (**a–h**) Patient in case study, before (*left*) and 2 years after (*right*) surgery to correct her nose's width and other issues

ASYMMETRIC DEVIATED NOSE (CASE STUDY)

Analysis: A 20-year-old student presented for rhinoplasty. Her complaints in order of importance were crookedness, beak on profile, and plunging tip. She felt that the nose was just too big for her 5′0″ stature, and she wanted a major change. Her nasal walls were asymmetric with significant differences in height: R convex (20 mm), L concave (27 mm). The nose and face were both deviated to the right (Fig. 3.51).

Operative Technique:

1) Open approach. Alar cartilages reduced to 6 mm rim strips.
2) Dorsal reduction on an angle, preserving ULC. Dorsal cartilage reduction (4 mm at ASA, 1 mm at keystone).
3) Septal body resection. Caudal septal relocation R to L. Medial oblique and L-L osteotomies.
4) R bone moved in, L bone moved out. Spreader graft forced high on the L side and fixed using a drill hole. Add-on: "doorstop" spreader on L. Spreader flap on R.
5) Insertion of columellar strut. Tip sutures; CS, DC, ID, DE.

Commentary: Obviously, this patient had a significant ADDN (Fig. 3.52). Because a significant hump reduction would be done, the 7-mm difference in lateral wall height would be equalized through asymmetric hump reduction. Straightening of the bony vault required that the right wall be moved *inward* while the left wall was moved *outward* and held there using a major spreader graft. The additional "doorstop" spreader on the left meant that the two spreader grafts on the left added 4 mm of width near the ASA (Fig. 3.51d).

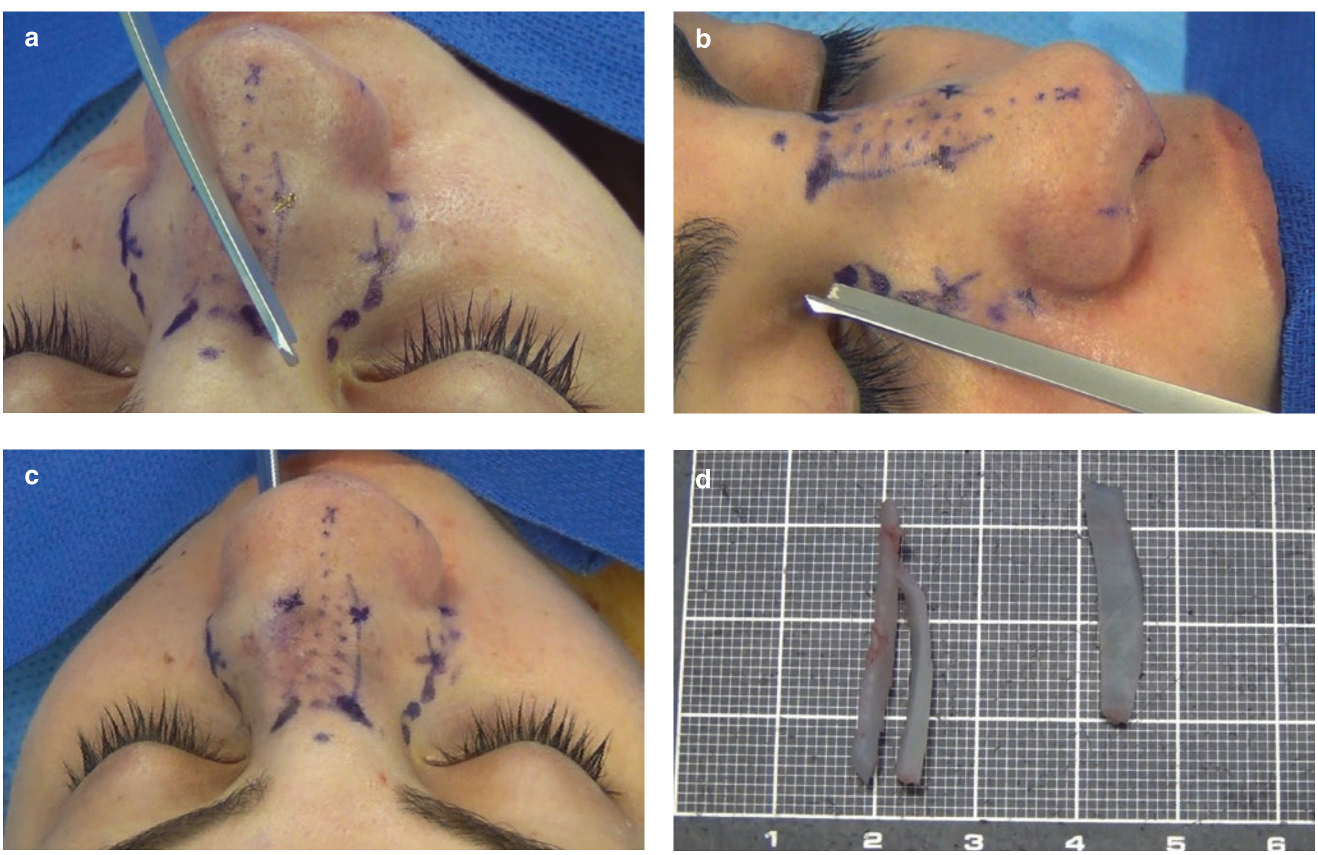


Fig. 3.51 Asymmetric developmental deviated nose (ADDN). (**a**, **b**) Medial oblique and L–L osteotomy to move right nasal bone inward. (**c**) Prying outward the left nasal bone with a medial oblique osteotomy. (**d**) Stabilizing outward the left wall with full-length and "door stop" spreader grafts on the left side only

ASYMMETRIC DEVIATED NOSE (CASE STUDY)

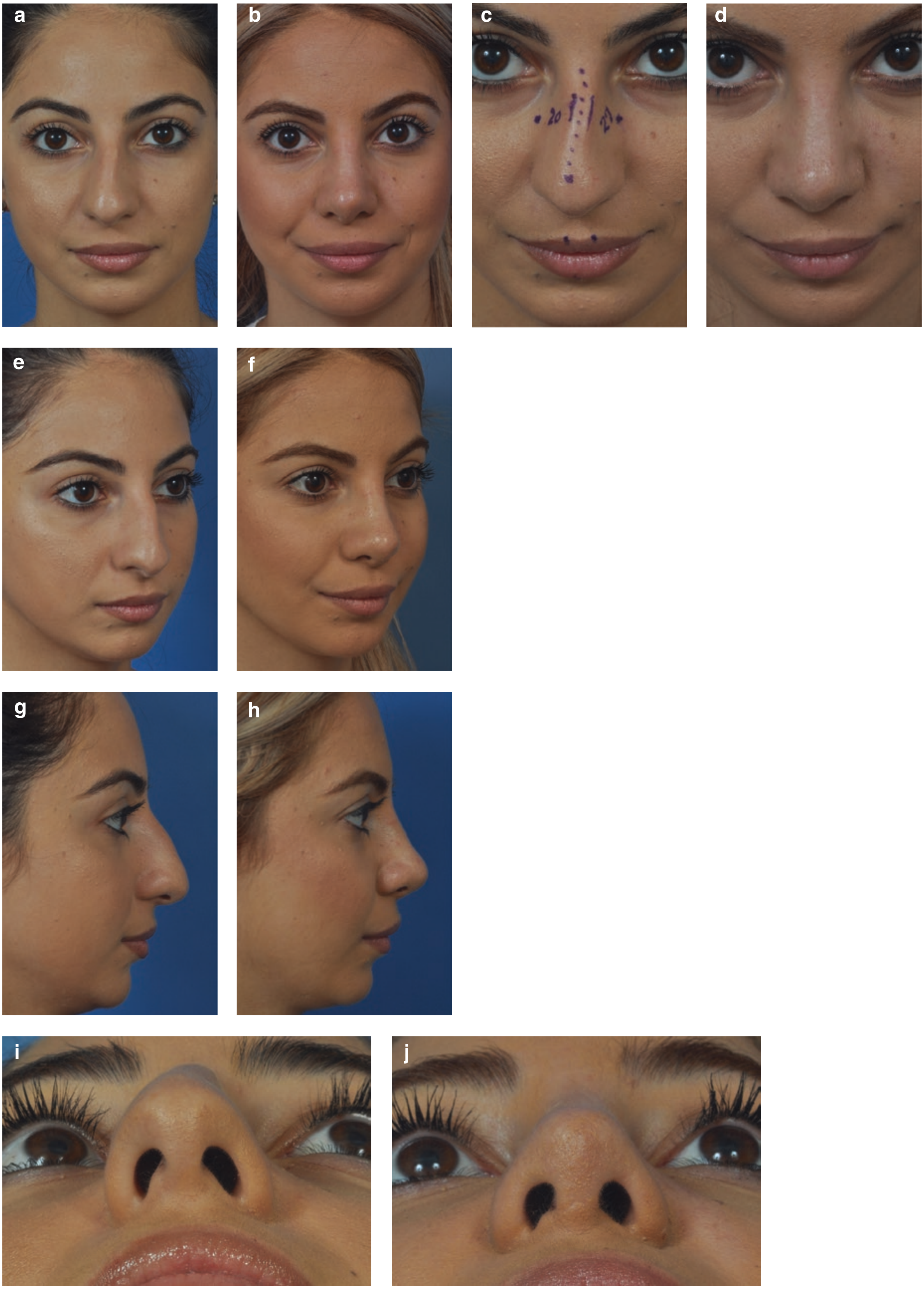


Fig. 3.52 (**a–j**) Patient in case study, before (*left*) and one year after (*right*) surgery to correct her nose's asymmetry

DORSAL PRESERVATION (PUSH DOWN TECHNIQUE - SABAN MODIFICATION)

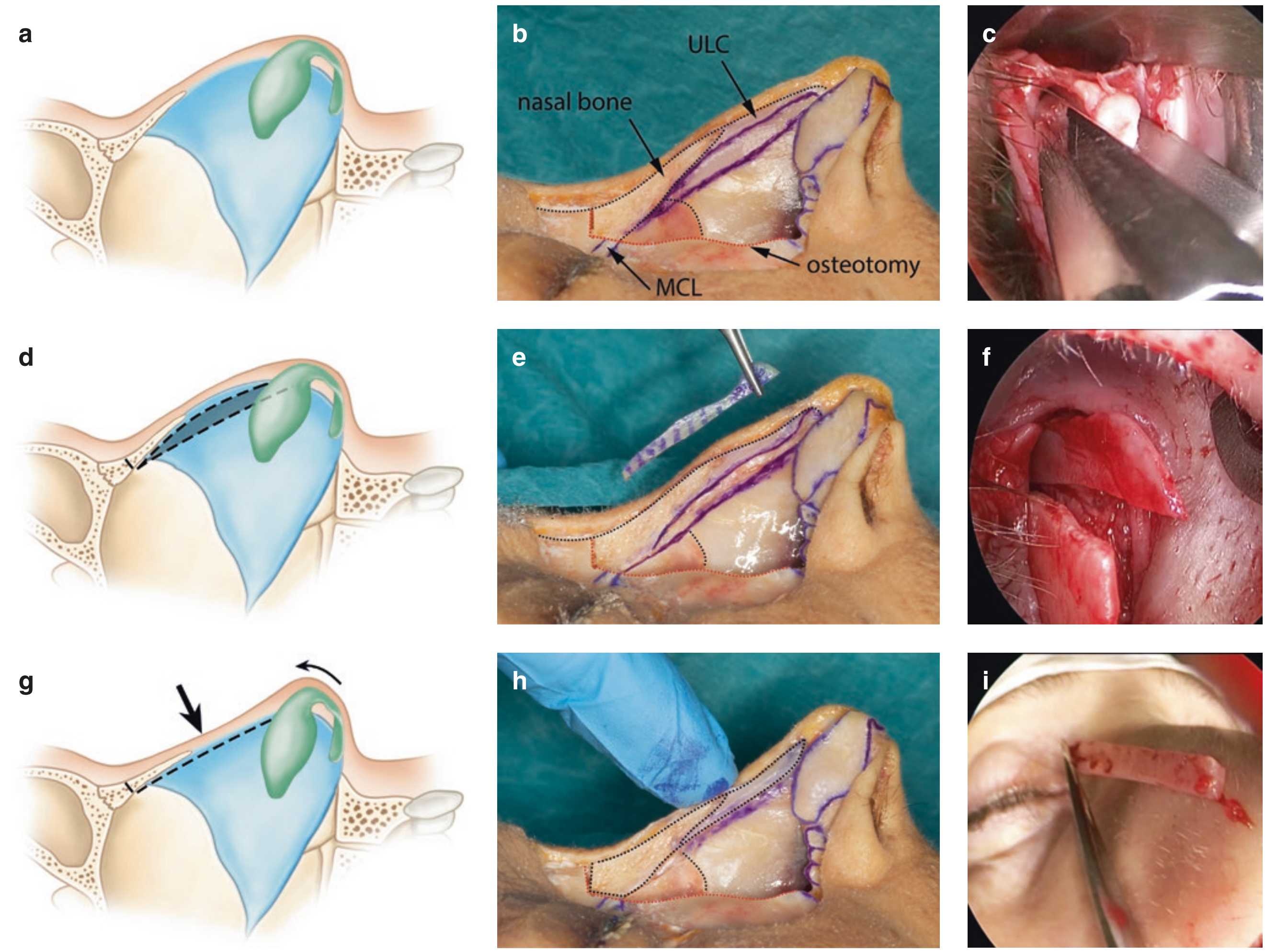


Fig. 3.53 The Saban Push Down Technique of dorsal preservation. (**a**–**c**) Location of septal strip excision just below the osseocartilaginous vault. (**d**–**f**) Amount of septal excision correlates directly with the amount of desired dorsal lowering. (**g**–**i**) Impaction of dorsum downward eliminates the convexity

The **push down operation** was pioneered by Lothrop (1914) and popularized by Cottle (1954). The operative goal is to eliminate the dorsal convexity without excision of the keystone area (Fig. 3.53). This **dorsal preseservation** is achieved with the following three steps: (1) excision of a septal strip, (2) total mobilization of the bony vault using osteotomies, and (3) pinching of the bony nasal walls and downward impaction of the osseocartilaginous vault. Central to the procedures is the location of the septal excision which can be subdivided into the classic low location of Cottle with its associated ante-rotation (Drumheller 1993) versus the high subdorsal resection championed by Saban et al. (2006) which permits a direct lowering. As shown in Fig. 3.53, a septal strip, whose height corresponds to the desired dorsal, reduction, is excised high under the dorsum through the septal cartilage and a portion of the perpendicular plate. Then, the osteotomies are done, both laterally and transversely. The surgeon must decide which method of bony mobilization is planned—a push down or a let down (Figs. 3.54 and 3.55). The classic **push down** involves complete lateral osteotomies whereas the **let down** involves excision of a tapered triangle of frontal process of maxilla. Then, the transverse osteotomies are done from one side across the radix to the opposite side which results in total mobility of the nasal pyramid. The nose can then be let down to rest on the maxilla. Alternatively, the bony vault can be impacted downward using the following three steps: (1) transverse movement of the nose to insure total mobilization,

DORSAL PRESERVATION (PUSH DOWN TECHNIQUE - SABAN MODIFICATION)

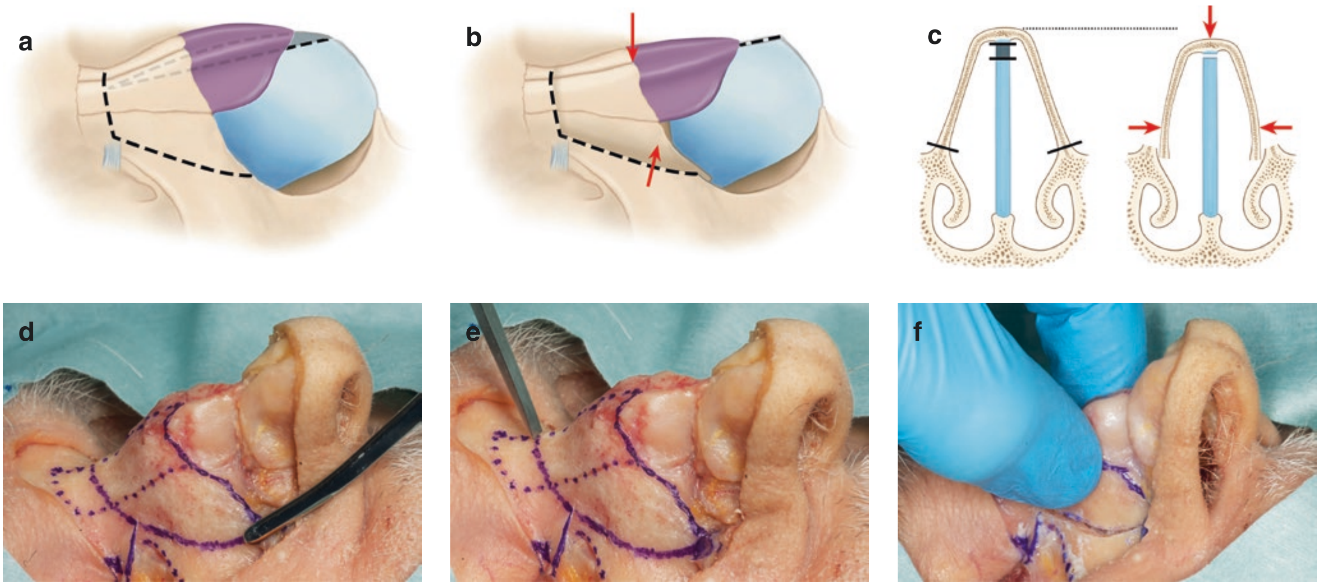


Fig. 3.54 (**a**–**f**) Following complete osteotomies, the dorsal vault is *pushed down* into the nasal vault

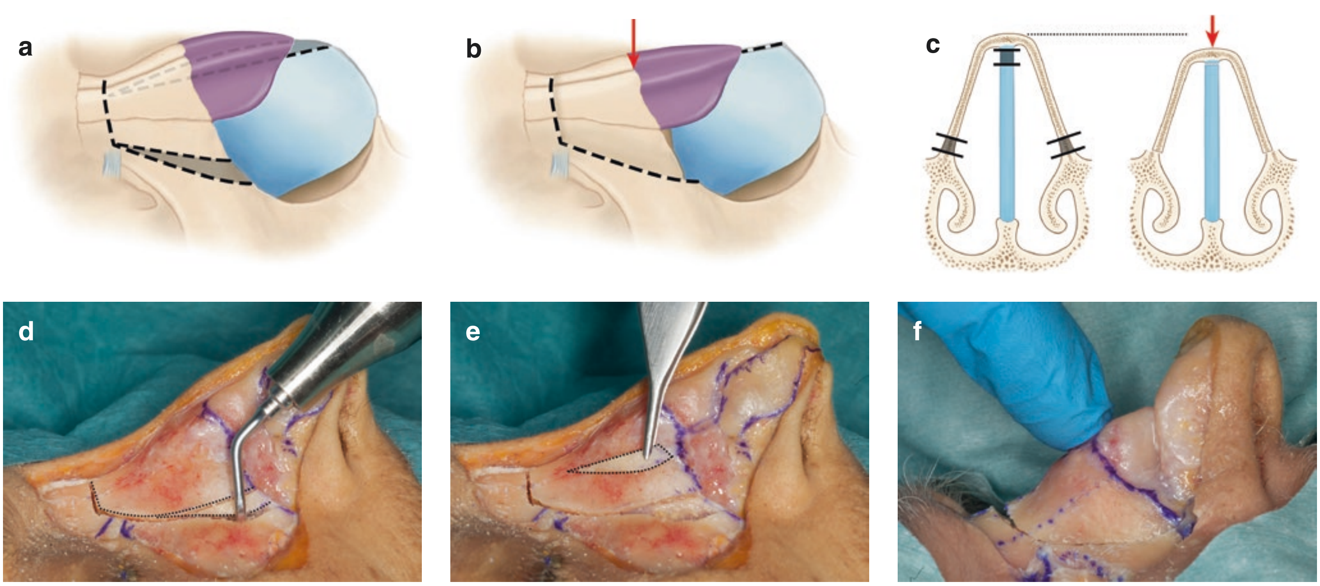


Fig. 3.55 (**a**–**f**) Following excision of a strip of frontal process of maxilla, the bony vault is *let down* to rest on the frontal process of the maxilla

(2) pinching the bony sides of the nasal vault symmetrically, and (3) downward movement of the bony pyramid into the nasal fossa. In a true push down, the lateral nasal walls slide inside the frontal process of the maxilla. Why does this procedure work? Essentially, the keystone area is truly a "chondro-osseous joint" supported by the septal pillar. Once the strip of septum is removed, the dorsal hump can flatten without the need to excise and reconstruct the keystone area. Clinical indications for this procedure have recently been published (Saban et al. 2018).

PUSH DOWN (SABAN MODIFICATION) (COURTESY OF DR. YVES SABAN)

Analysis: A 26 years old female presented with a tension nose. She was an excellent candidate for a dorsal preservation procedure as she had a high, thin, straight cartilaginous dorsum and minimal deformity of the bony vault. Removal of an 8 mm septal strip plus a push down of the bony vault was planned.

Operative Technique:

1. Intranasal approach with dorsal soft tissue undermining.
2. Caudal septal access posterior to membranous septum to preserve ligaments. Subperichondrial bilateral undermining of the septal mucosa, leaving the perichondrium attached to the inferior 2/3 of the septum on the left side (i.e., swinging door technique).
3. Septal cartilage strip (6 mm) excision just below the osseocartilage vault up to the nasofrontal angle.
4. Resection of a small piece of perpendicular plate.
5. Lower lateral bony wall resection using a 4 mm rongeur at the level of the nasofacial groove and extended by lateral osteotomies cranially.
6. Transverse percutaneous osteotomies of the radix to separate the bony pyramid from the facial skeleton.
7. Pinching the bony lateral walls and pushing the nose down. Further lowering of the septum with a 2 mm excision.
8. Suturing the cartilaginous vault to the resected septum.

Commentary: In case of larger hump reduction, it is practical to resect the lower lateral part of the lateral bony wall, in order to make the nasal lowering easier. In case of smaller hump (<4 mm), complete osteotomies are sufficient to lower the bony vault. Since the septum is a support pillar of the dorsum, it is better to resect the septal strut incrementally—6 mm initially and than 2 mm more. Skin undermining avoids the risk of skin incarceration between the bony edges.

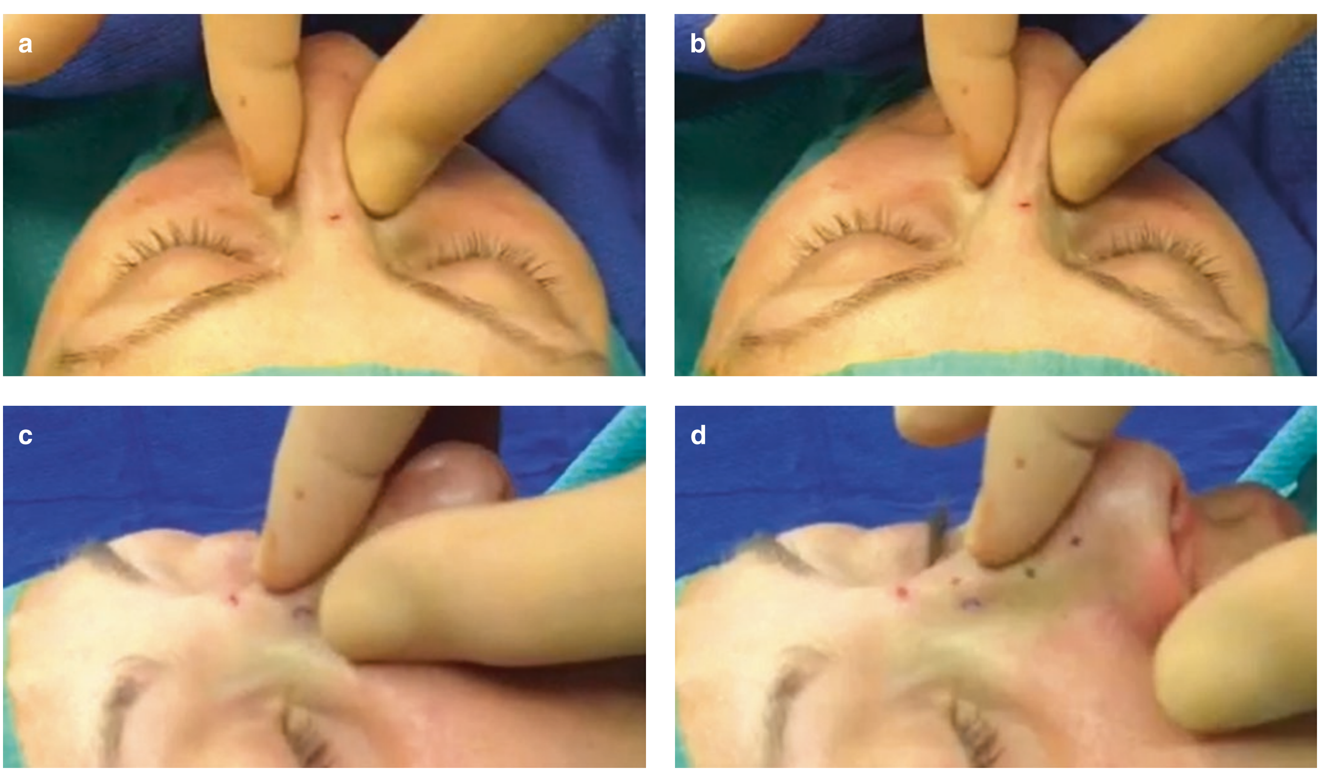


Fig. 3.56 (**a–d**) Mobilisation and pushing down of the nose

PUSH DOWN (SABAN MODIFICATION) (COURTESY OF DR. YVES SABAN)

Fig. 3.57 (**a–h**) Patient before and 1 1/2 years after dorsal preservation surgery with an 8 mm let down technique to eliminate the dorsal convexity

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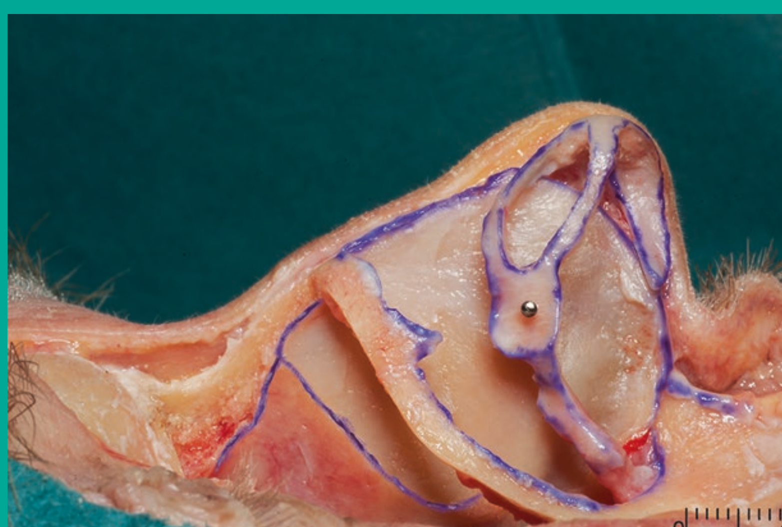
4 Septum, Turbinates, Valves



Every rhinoplasty operation must achieve the two interrelated goals of form and function. An attractive nose with compromised respiration is not a success, nor is an unattractive nose with improved respiration acceptable. A classic example of this challenge is the asymmetric nose in which the septal deviation causes a crooked external appearance while obstructing the internal airway. The multiple structures that influence nasal respiration must be addressed collectively as the *functional factors*, with primary focus on the septum, turbinates, and nasal valves. Obviously, numerous physiological factors, including mucosal changes, also influence nasal respiration, but as surgeons our focus eventually becomes more structural. Septal surgery can vary from simple excision to more complex replacement and eventually reconstruction. The nasal valves are complex, but ultimately their deficiencies are of anatomical origin, and surgery must restore their structural support. Surgeons should spend as much time planning their functional procedures as they do their aesthetic changes, to ensure that both form and function are maximized.

OVERVIEW OF ANATOMY

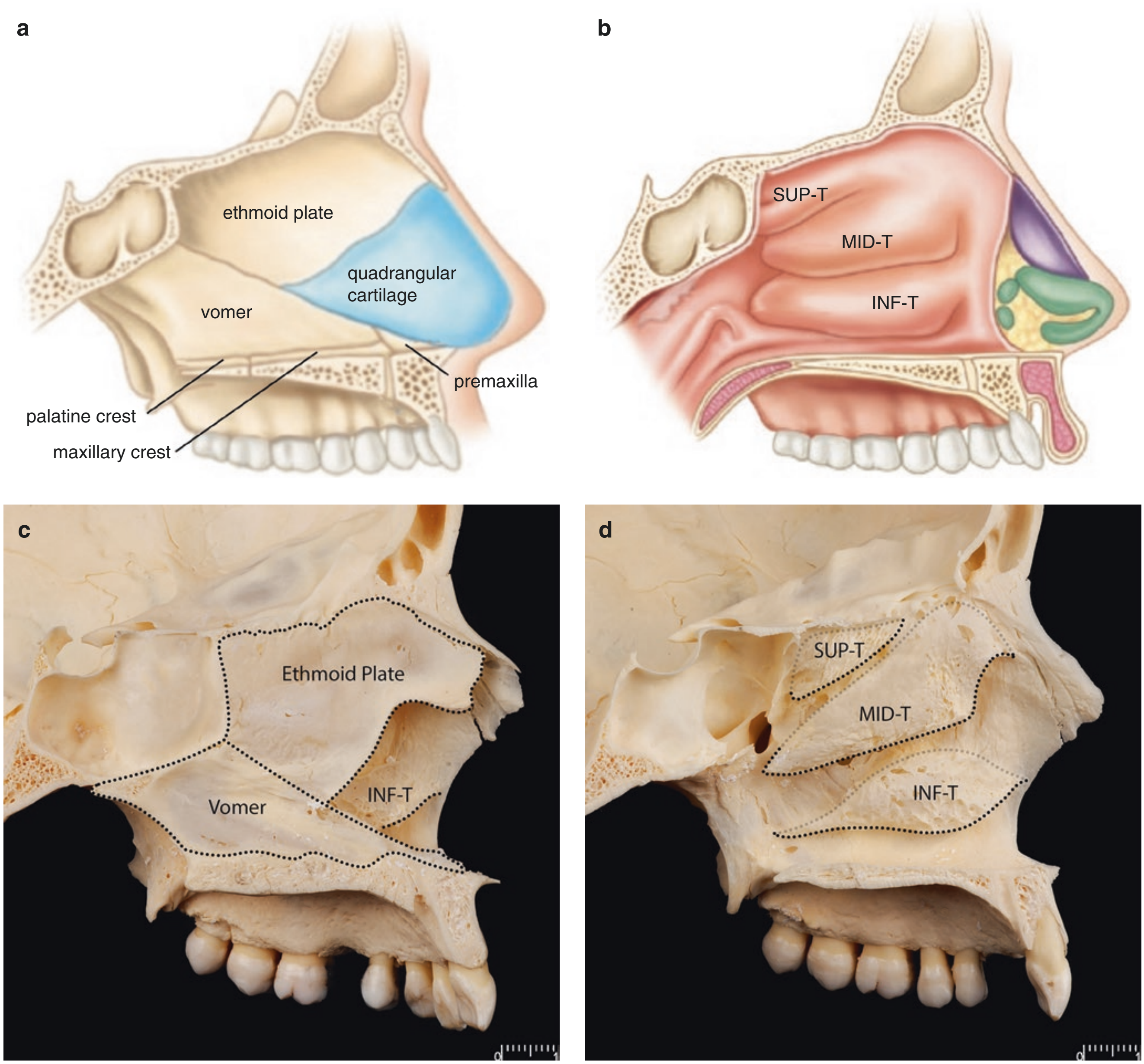


Fig. 4.1 (**a–d**) Septum and turbinates. INF-T—inferior turbinate; MID-T—middle turbinate; SUP-T—superior turbinate

Surgeons need to understand the anatomy of the septum, lateral nasal walls, and valve areas. The septum, an osseocartilaginous structure, separates the nasal cavity into two chambers (Fig. 4.1). The septal partition is rigid, whereas the lower lateral wall and tip lobule are very dynamic. Three dynamic valves can be classified: (1) nostril/external, (2) vestibular, and (3) internal (Fig. 4.2). The *external valve* is composed of those structures that form and project into the nostril aperture, including the columella, caudal septum, crural footplates, soft-tissue alar rim, alar lobule, and nostril sill. The *vestibular valve* sits between two narrow apertures (the nostril and internal valves), with the most common obstructions being lateral alar collapse or vestibular webbing. The internal valve has two parts: the narrow, slit-like *internal valve angle* and the larger *internal valve area.*

OVERVIEW OF ANATOMY

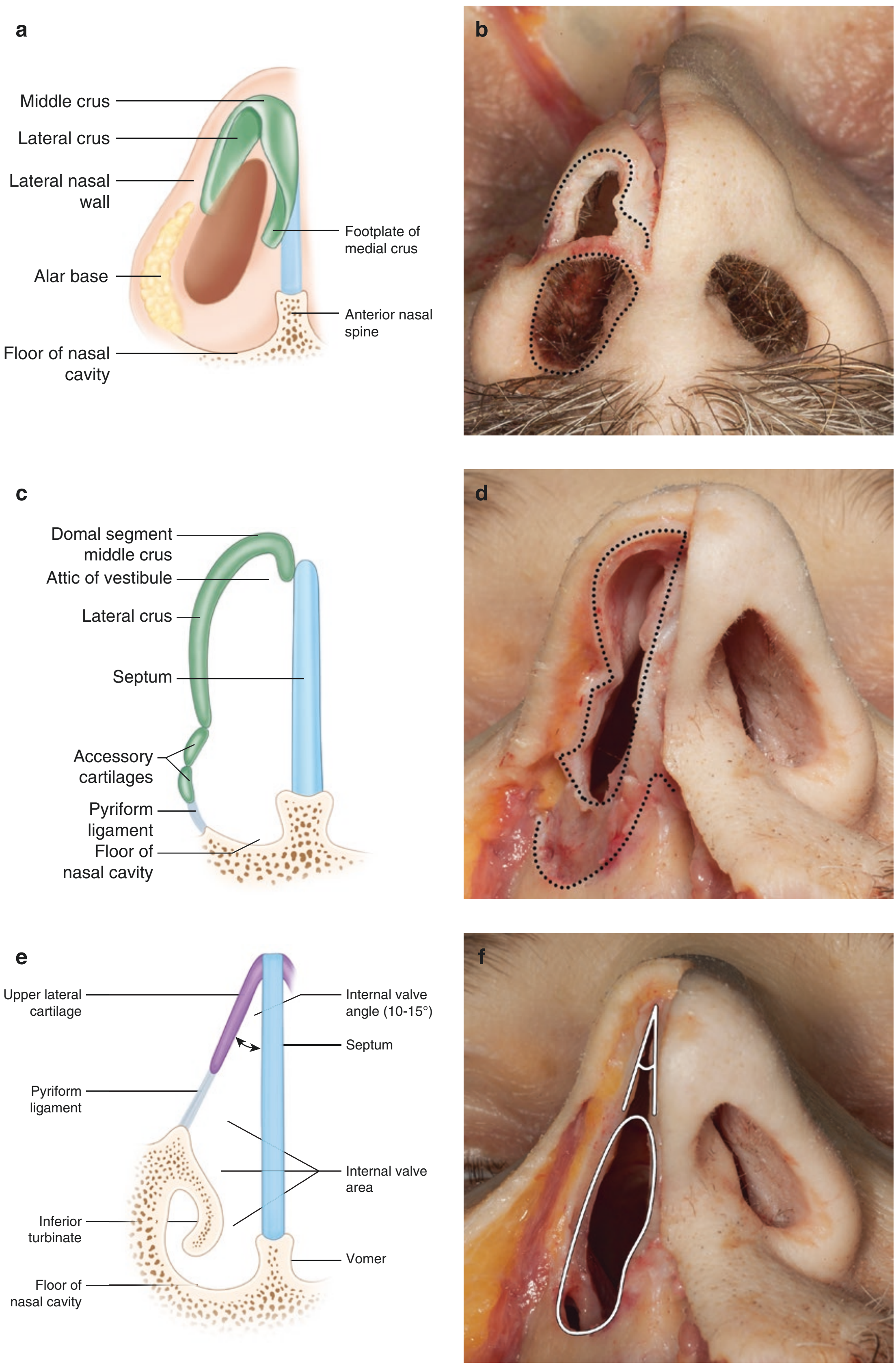


Fig. 4.2 Overview of the (**a, b**) external/nostril valve, (**c, d**) vestibular valve, and (**e, f**) internal valve

FUNCTIONAL ANATOMICAL CHOKEPOINTS

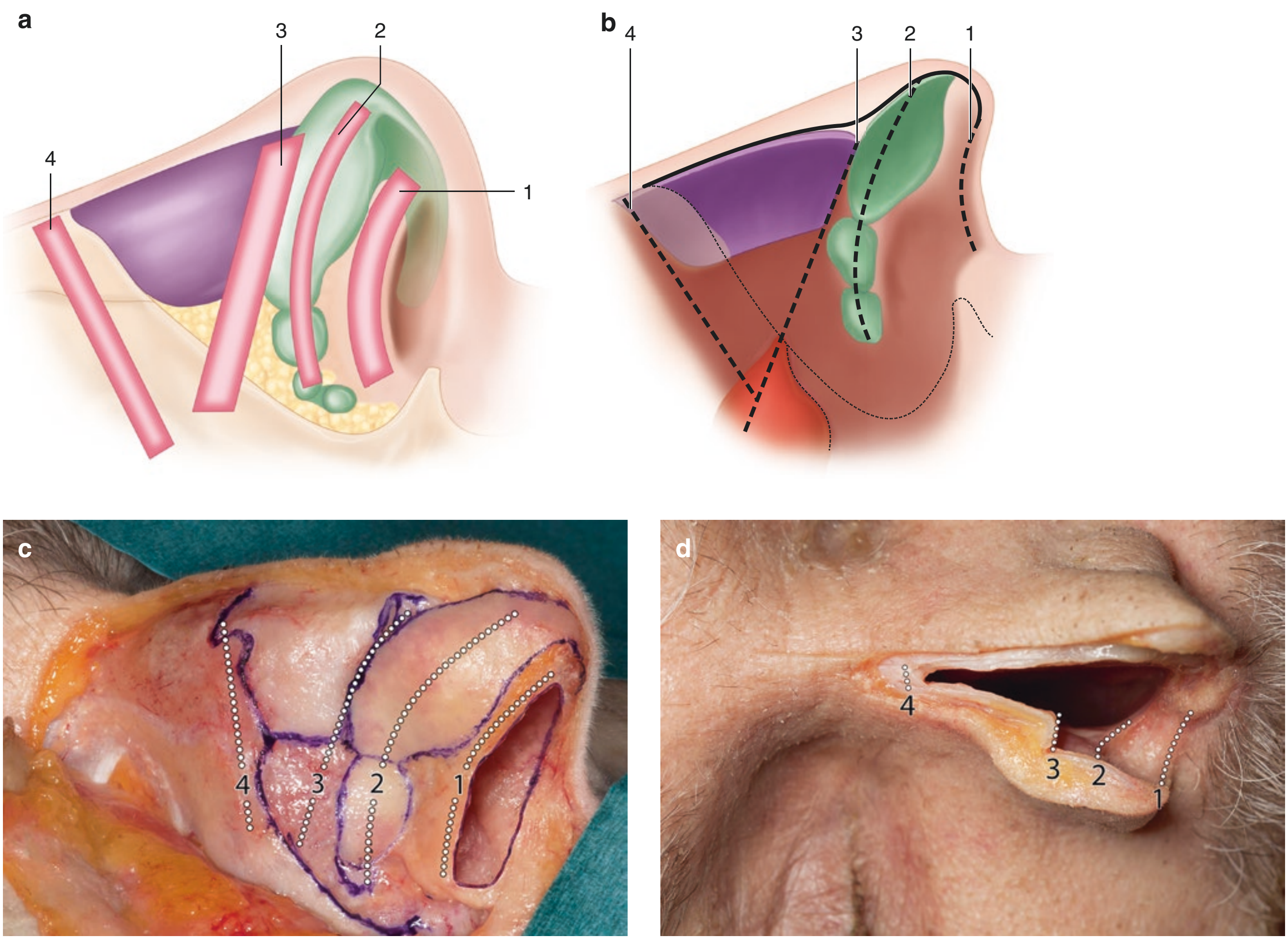


Fig. 4.3 (**a–d**) Anatomical chokepoints: (1) nostril, (2) vestibule, (3) internal valve, and (4) nasal bones

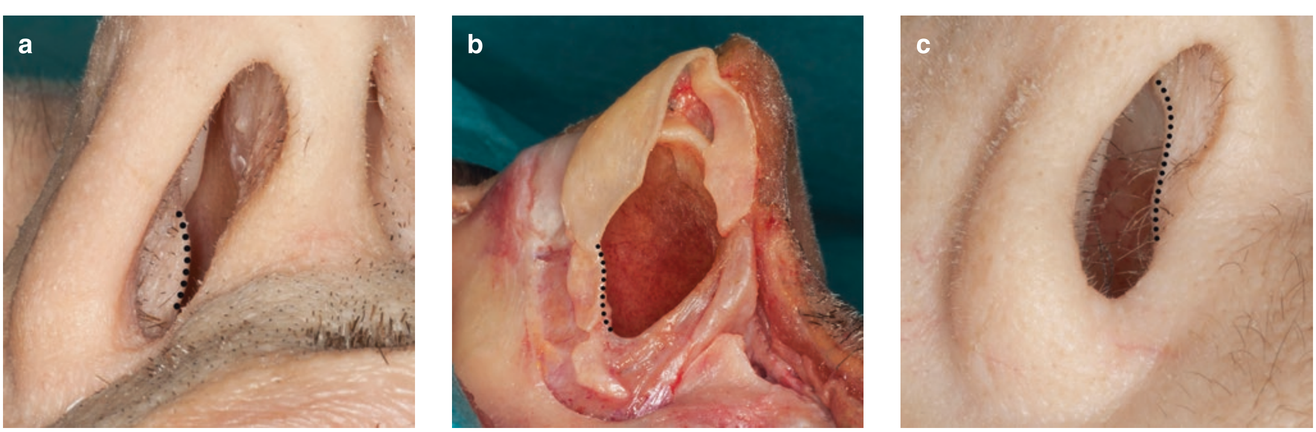


Fig. 4.4 (**a**) Posterior vestibular fold. (**b**) A1 accessory cartilage. (**c**) Retrocolumellar fold

In contrast to rhinologists, who view the nose as a series of dynamic valves, surgeons tend to see a wide variety of anatomical deformities that impinge on the nasal airway and reduce air flow. Rather than considering them normal dynamic nasal valves, we tend to categorize these areas as pathological *anatomical chokepoints*, which must be treated surgically (Fig. 4.3). The nostril opening (Area 1) can be easily blocked by a deviated caudal septum or a collapsed alar rim. The vestibule, with its posterior vestibular fold and accessory cartilages (Figs. 4.4 and 4.5), is a well-defined anatomical chokepoint (Cottle 1955).

FUNCTIONAL ANATOMICAL CHOKEPOINTS

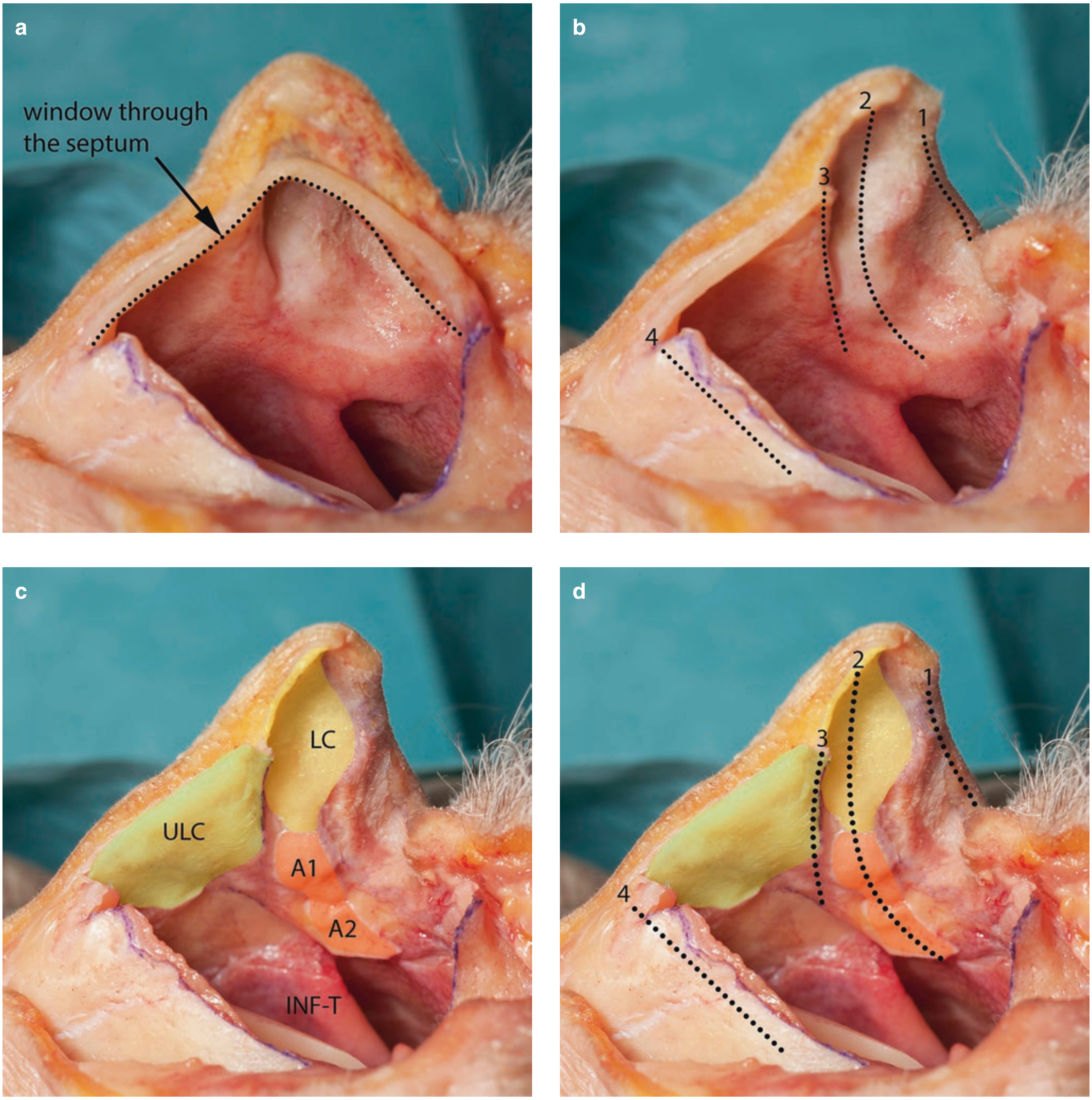


Fig. 4.5 (**a–d**) External, vestibular, internal, and bony valves from the inside. LC—lateral cartilage; ULC—upper lateral cartilage

The junction of the upper lateral and alar cartilages has long been considered a flow-limiting segment, termed the *internal valve*. However, one must subdivide the internal valve into an internal valve **angle** and an internal valve **area**. Increasingly, we are beginning to recognize a collapsible lateral wall. The bony lateral nasal wall (Area 4) can be displaced medially to block the cavum. This occurrence is quite common following trauma or surgery. Its correction often requires movement of the lateral bony wall outward, followed by stabilization with a long, cephalically placed spreader graft.

AESTHETICS

Fig. 4.6 Caudal septum: (**a**) straight, (**b**) deviated and (**c**) curved. (**d–f**) Crooked nose. (**g, h**) Asymmetric nose

The septum's influence on nasal aesthetics is visible in frontal and basilar views. On the basilar view, the columella often appears deviated to one side, most often owing to a true caudal septal deviation. However, one must differentiate between caudal septal deviation, anterior nasal spine (ANS) displacement, and asymmetry of the medial crus. When the caudal septum is deviated to one side, it can be relocated to the midline and fixed to the ANS. On frontal view, dorsal deviations are readily apparent, but their etiology can be confusing. The surgeon must determine the contribution of septal deviation versus asymmetry of the osseocartilaginous vault. We often use the "head down" view to determine septal deviation and the "head up" view to assess asymmetry of the vaults. As shown in Fig. 4.6, a combined deformity is often present, which requires both septal correction and asymmetric surgical modifications of the vaults (Kosins et al. 2016).

THE SEPTUM: ANATOMY IN DEPTH

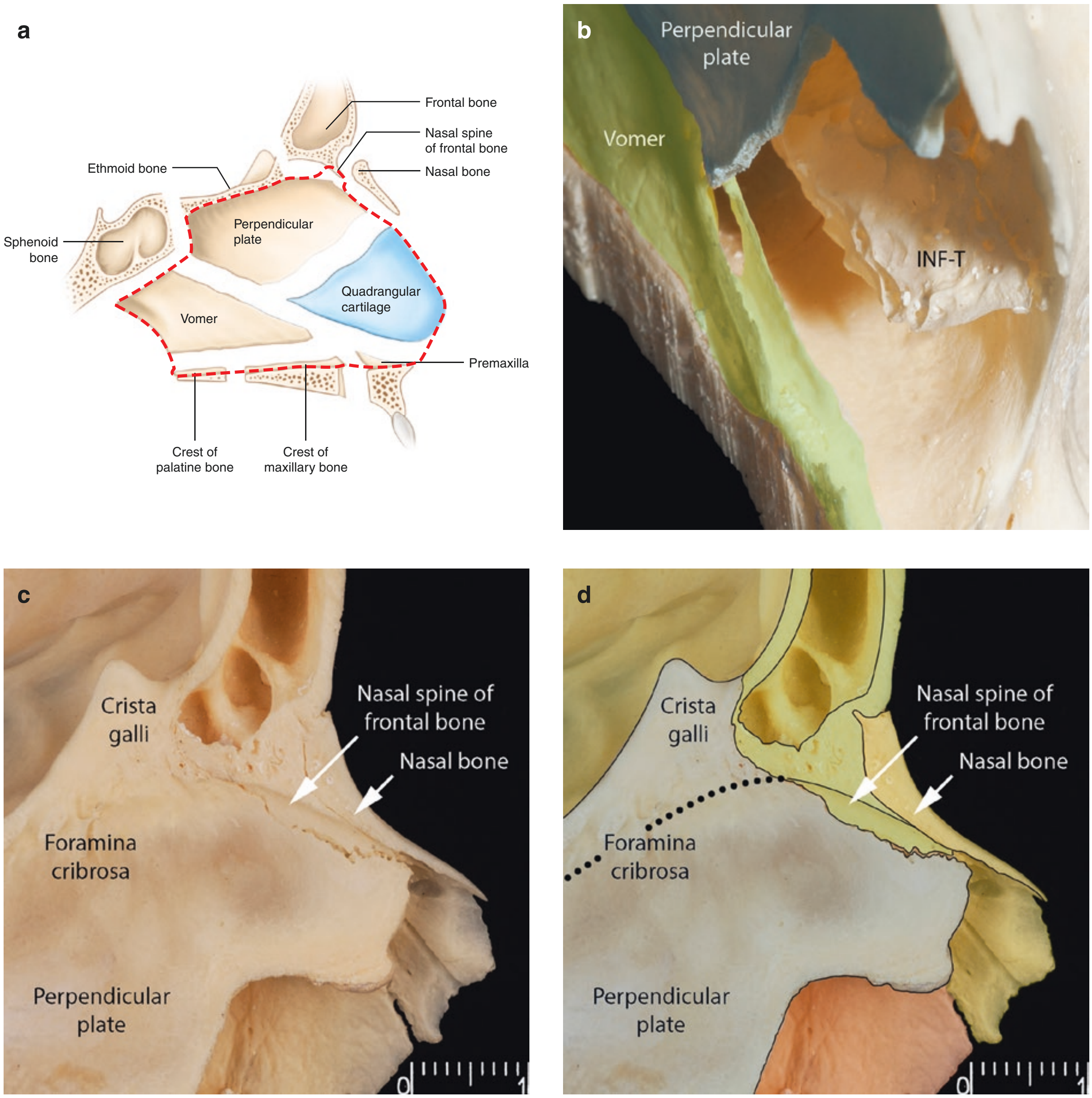


Fig. 4.7 (**a–d**) Detailed anatomy of the septum

The septum is composed of the quadrangular cartilage and five bones: premaxilla, crest of the maxillary bone, crest of the palatine bone, vomer, and perpendicular plate of the ethmoid (Fig. 4.7a) (Unger 1965). The palatine process of the paired *maxilla* forms the floor of the nose and has a groove that articulates with the vomer, called the crest of the maxillary bone. The horizontal part of the *palatine bone* contributes to the posterior fourth of the hard palate, articulates with the maxillary crest anteriorly, and bifurcates superiorly for its junction with the vomer. The *vomer* is an unpaired bone that is interposed between the maxillary and palatine crests below, with the quadrangular cartilage and perpendicular plate above (Fig. 4.7b). The vast majority of septal spurs consist of vomerine bone overlaid with the sphenoid extension of the cartilaginous septum. The *ethmoid bone* has three parts: the perpendicular plate, ethmoidal labyrinth, and cribriform plate. Bony deviations of the perpendicular plate are quite common. If the surgeon twists and rotates the bone during resection of a deviation, then one can risk disruption of the cribriform plate. For this reason, the resection should be done downward, and we currently prefer the use of precise piezoelectric saws. The bony radix area involves three distinct bones: the nasal bone, frontal bone, and a distinct nasal spine of the frontal bone (Fig. 4.7c, d).

SEPTAL DEVIATIONS: GUYURON CLASSIFICATION

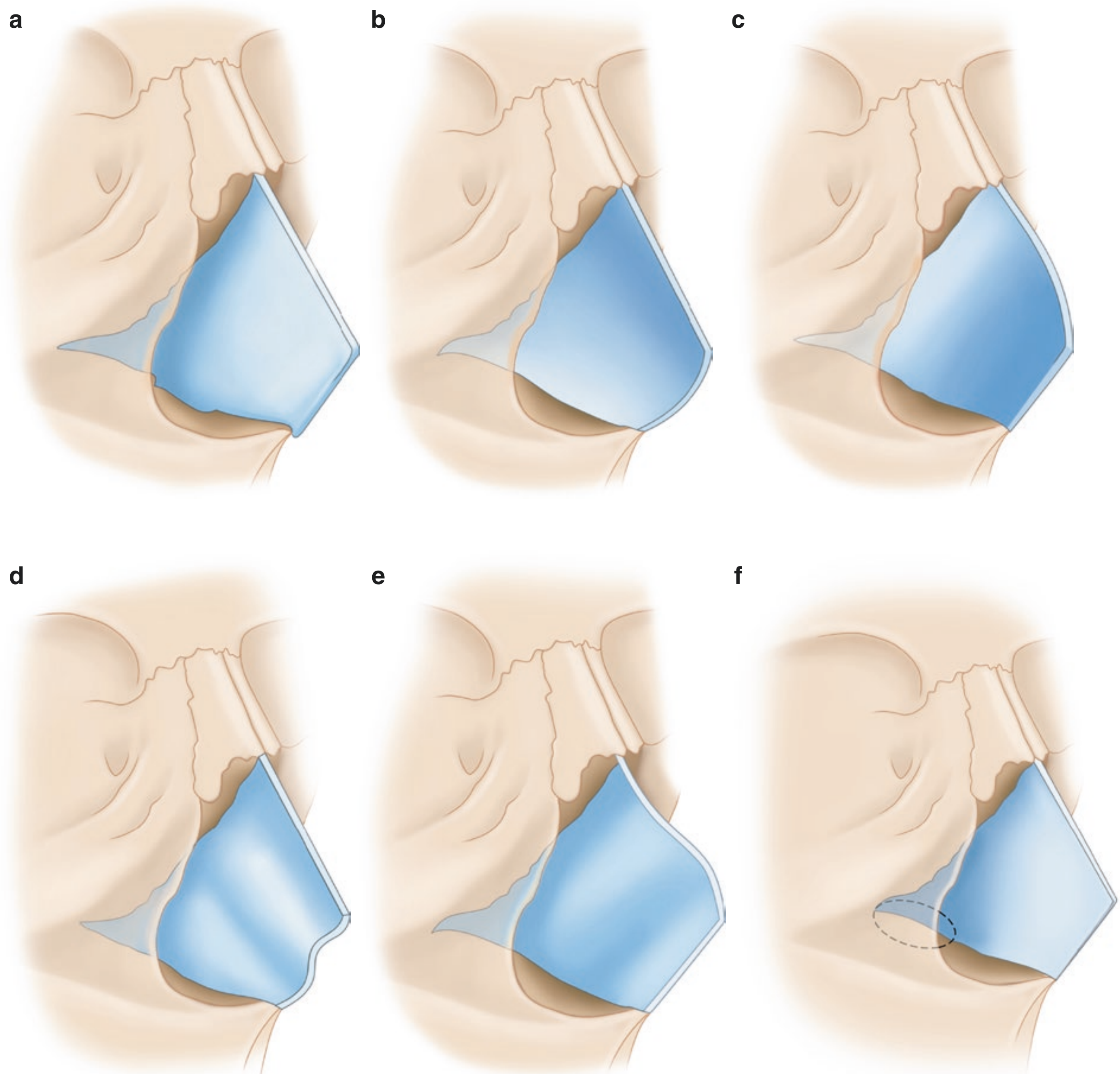


Fig. 4.8 (**a–f**) The Guyuron classification of septal deviations

Surgeons have tried to classify septal deviation using numerous criteria. In general, we find *etiology* to be particularly important and use the following subdivision: primary, post-traumatic, and secondary, with cleft and cocaine noses separate categories (Daniel 2002). Alternatively, septal deformities can be subdivided by *composition* and *location:* cartilaginous (body, caudal, dorsal) and/or bony (vomer, spur, body). Guyuron et al. (1999) classified septal deviations based on *shape* into six types (Fig. 4.8): (1) A septal tilt, where the septum has no true deviation, but rather is tilted to one side anteriorly and to the opposite posteriorly (40%); the ANS and maxillary crest are straight; (2) A C-shaped deformity with a distinct curvature in the anteroposterior plane (32%); the ANS and maxillary crest are deviated; (3) S-shape with a distinct curvature in the cephalocaudal plane (4%); (4) S-shape deformity with two opposing curvatures in an anteroposterior plane (9%); (5) S-shape in the cephalocaudal plane (1%); and (6) septal spur (14%), considered a localized deviation.

Another important characteristic that requires assessment is *structural integrity*, particularly in the nose with post-traumatic or secondary deviation (Figs. 4.9 and 4.10). A simple tip compression can often reveal the degree of septal support (Daniel 2007).

SEPTAL DEVIATIONS

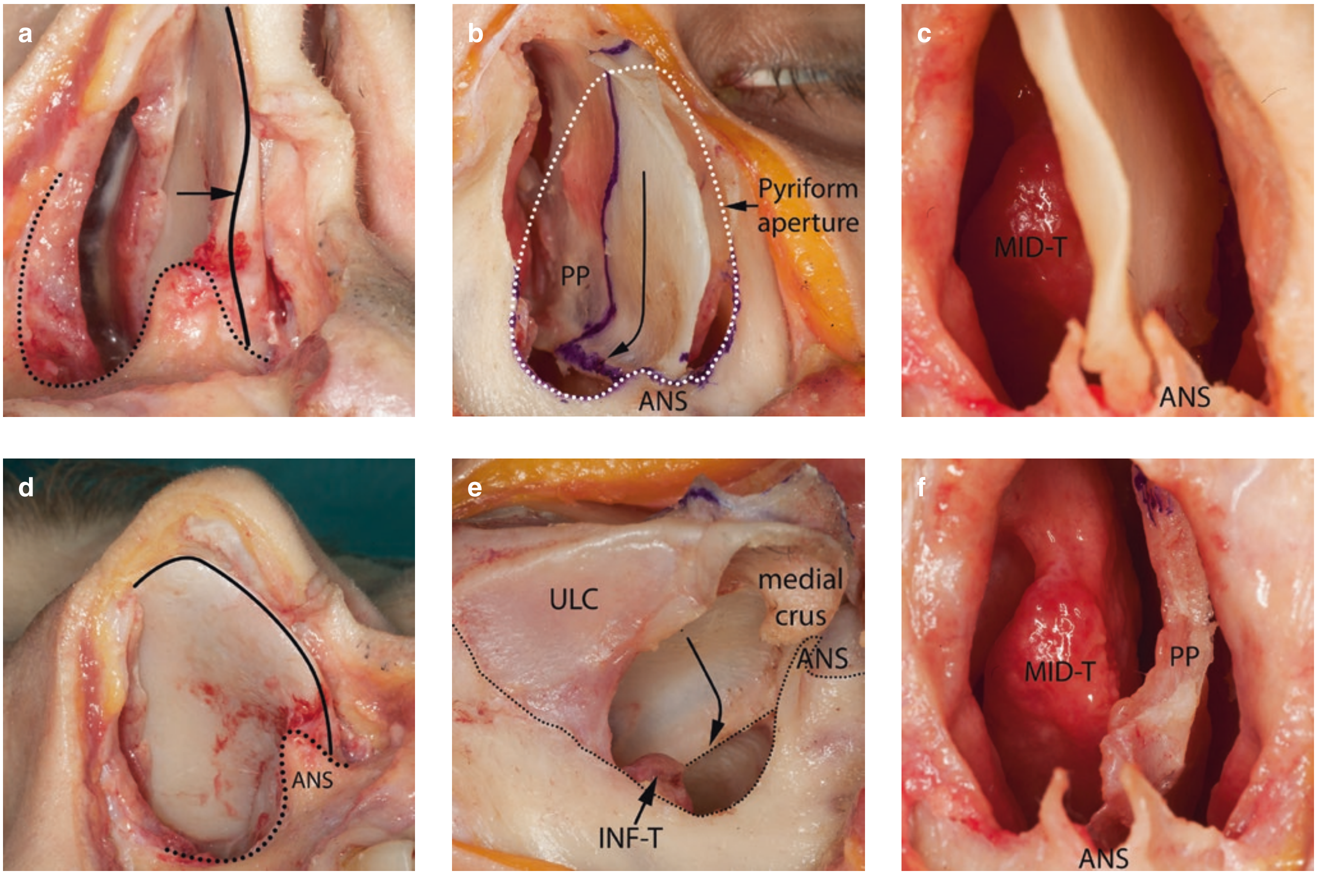


Fig. 4.9 (**a, d**) Caudal septum deviation in basilar and lateral view after nasal sidewall removal. (**b, e**) Septal body deviation in half basilar and half lateral view after nasal sidewall removal. (**c, f**) Perpendicular plate (PP) deviation before and after cartilaginous septum removal and associated middle turbinate (MID-T) hypertrophy (concha bullosa). *ANS* anterior nasal spine

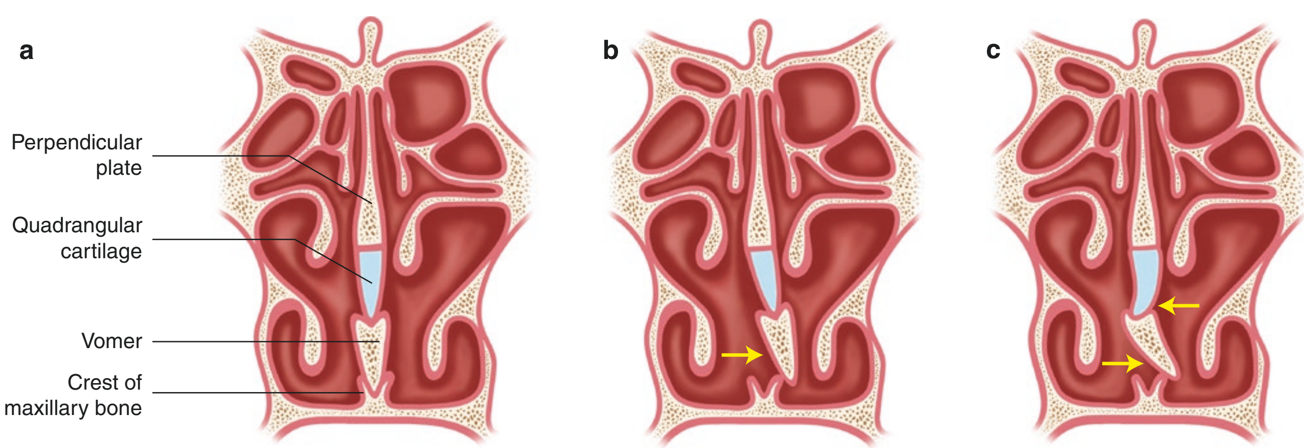


Fig. 4.10 Histological transection through the midportion of the septum. (**a**) Straight septum. (**b**) Vomerine deviation out of the maxillary crest. (**c**) Septal cartilage deviated out of the vomerine crest (After Unger 1965)

SEPTAL EXPOSURE: METHODS OF ACCESS

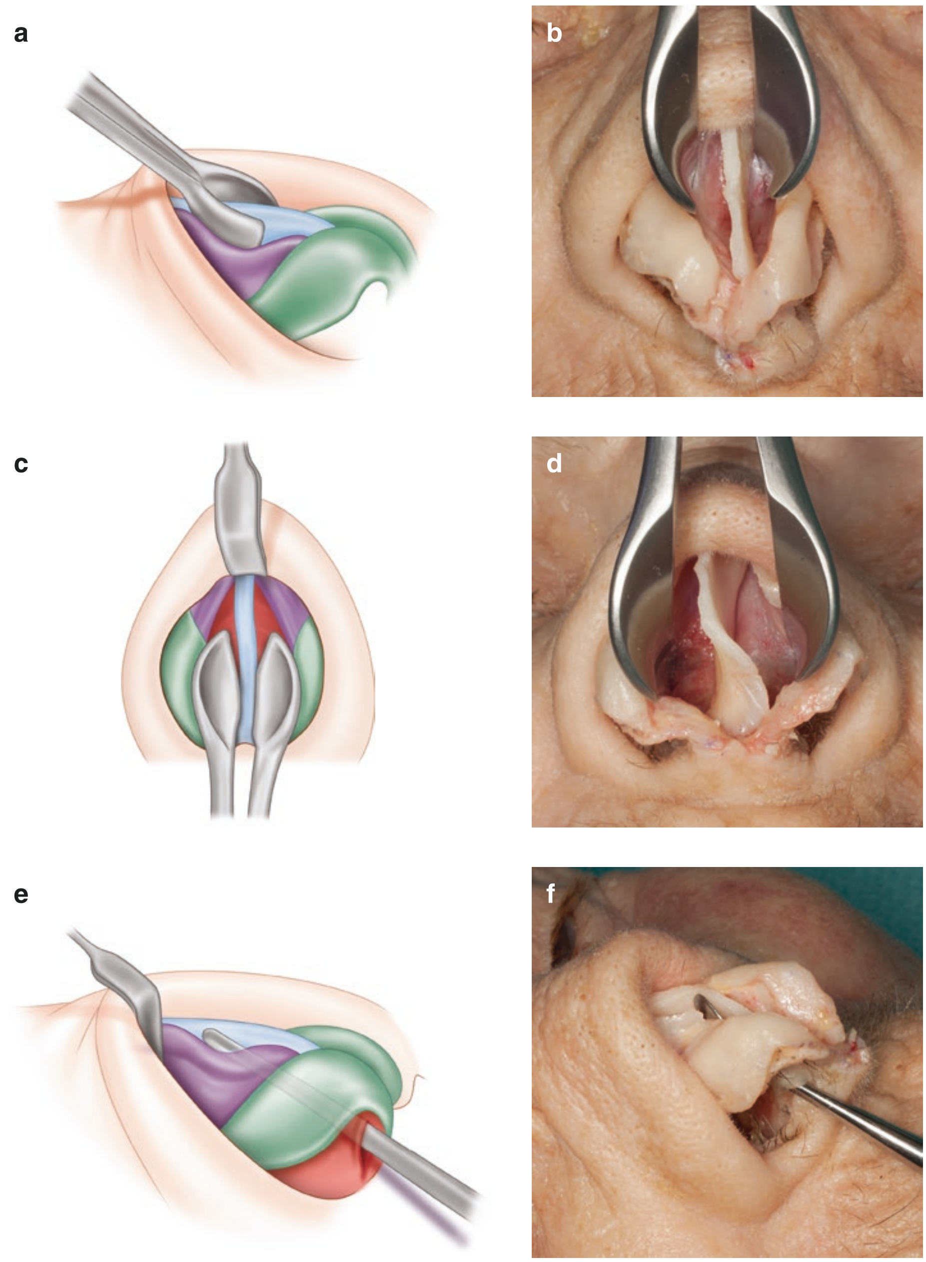


Fig. 4.11 Septal exposures. (**a, b**) Dorsal split, (**c, d**) combined dorsal/tip split, (**e, f**) transfixion

There are two distinct methods of gaining access to the septum: the transfixion approach and the top-down bidirectional approach. With the *transfixion* method (Fig. 4.11e, f), the caudal septum is exposed by retraction of the columella to the left. A vertical full-length transfixion incision is made 2–3 mm back from the caudal border on the right side. Using the angled converse scissors, the mucosa is elevated. The perichondrium is cross-hatched with a #15 blade and then scraped through to the cartilage using a dental amalgam. Once the perichondrium is elevated, the dissection continues posteriorly using a Cottle elevator. Inferiorly, the dissection is blocked at the junction of the cartilage with the maxillary crest, owing to the joint fascia where the perichondrium and periosteum meet. For most cases, this degree of exposure via an "anterior tunnel" is sufficient. The *top-down bidirectional* approach begins with downward traction on the alar cartilages, exposing the anterior septal angle and allowing easy access to the dorsal septum (Fig. 4.11a, b). Additional exposure can be gained by splitting the upper lateral cartilages (ULCs) off the cartilaginous dorsum (dorsal split), or splitting the alar cartilages in the midline (tip split) (Fig. 4.11c, d).

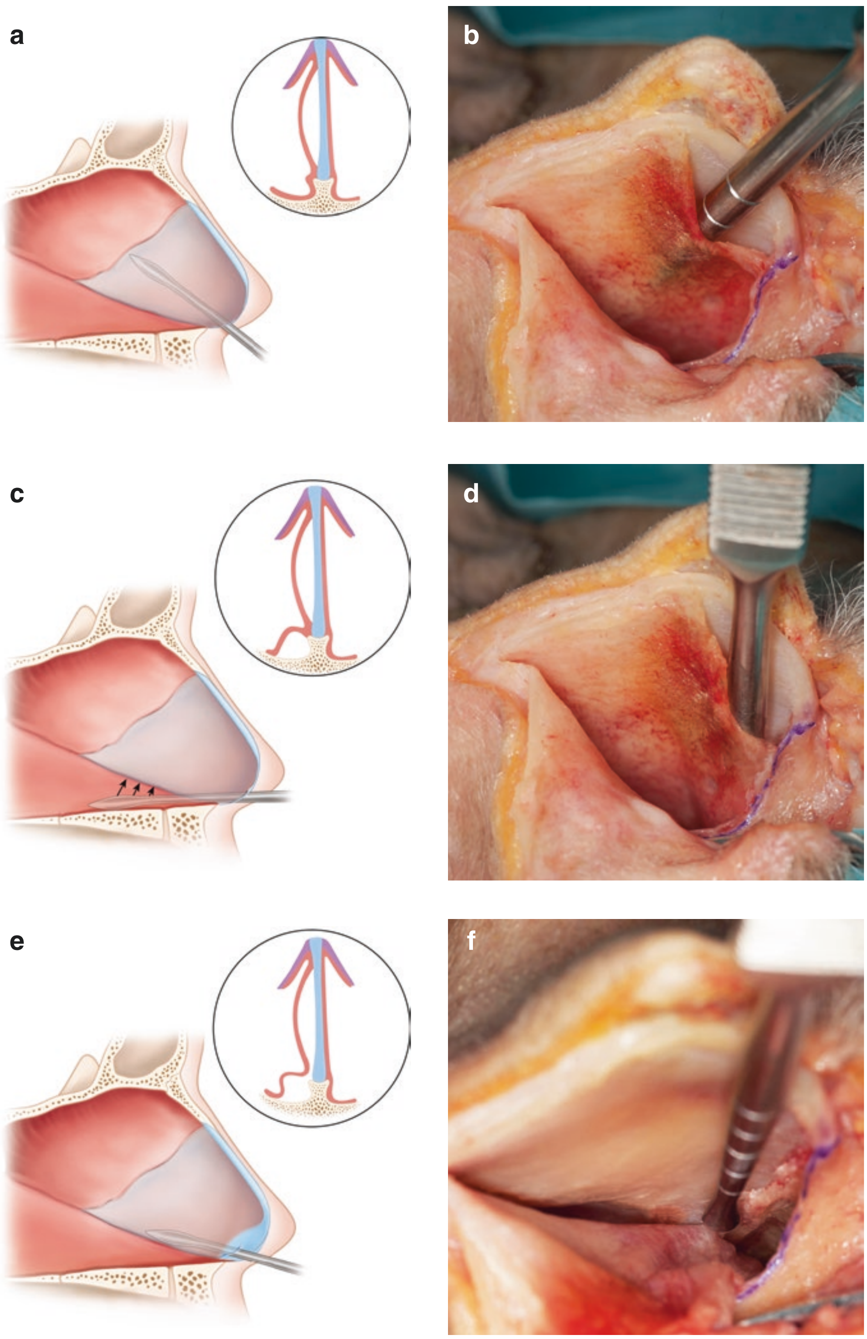


Fig. 4.12 (**a, b**) Anterior and (**c, d**) posterior tunnel are elevated and then (**e, f**) connected by dividing the interlacing "sling fibers" of perichondrium and periosteum

In routine cosmetic cases, elevation of an *anterior subperichondrial tunnel* is easily accomplished (Fig. 4.12a, b). Embryologically, the vomer and the perpendicular plate of the ethmoid are ossifications of the primordial cartilaginous septum, which allows for continuous dissection. The two danger zones requiring careful dissection are over any caudal vomerine deviation or a septal spur. Exposure of the caudal septum in the ANS and premaxillary region is challenging because of the joint interlacing perichondrial and periosteal fibers at the ANS and premaxilla. Therefore, a *posterior subperiosteal tunnel* is necessary to gain total access to the septum in a safe manner (Fig. 4.12c, d). With a curved MacKenty elevator, the vestibular lining overlying the premaxilla is raised and then continued posteriorly along the nasal floor, thereby creating the posterior tunnel. As one sweeps up the premaxilla, the *joint fascia* between periosteum and perichondrium is reached and carefully divided in an anterior-to-posterior direction (Fig. 4.12e, f).

SEPTOPLASTY: CARTILAGE RESECTION

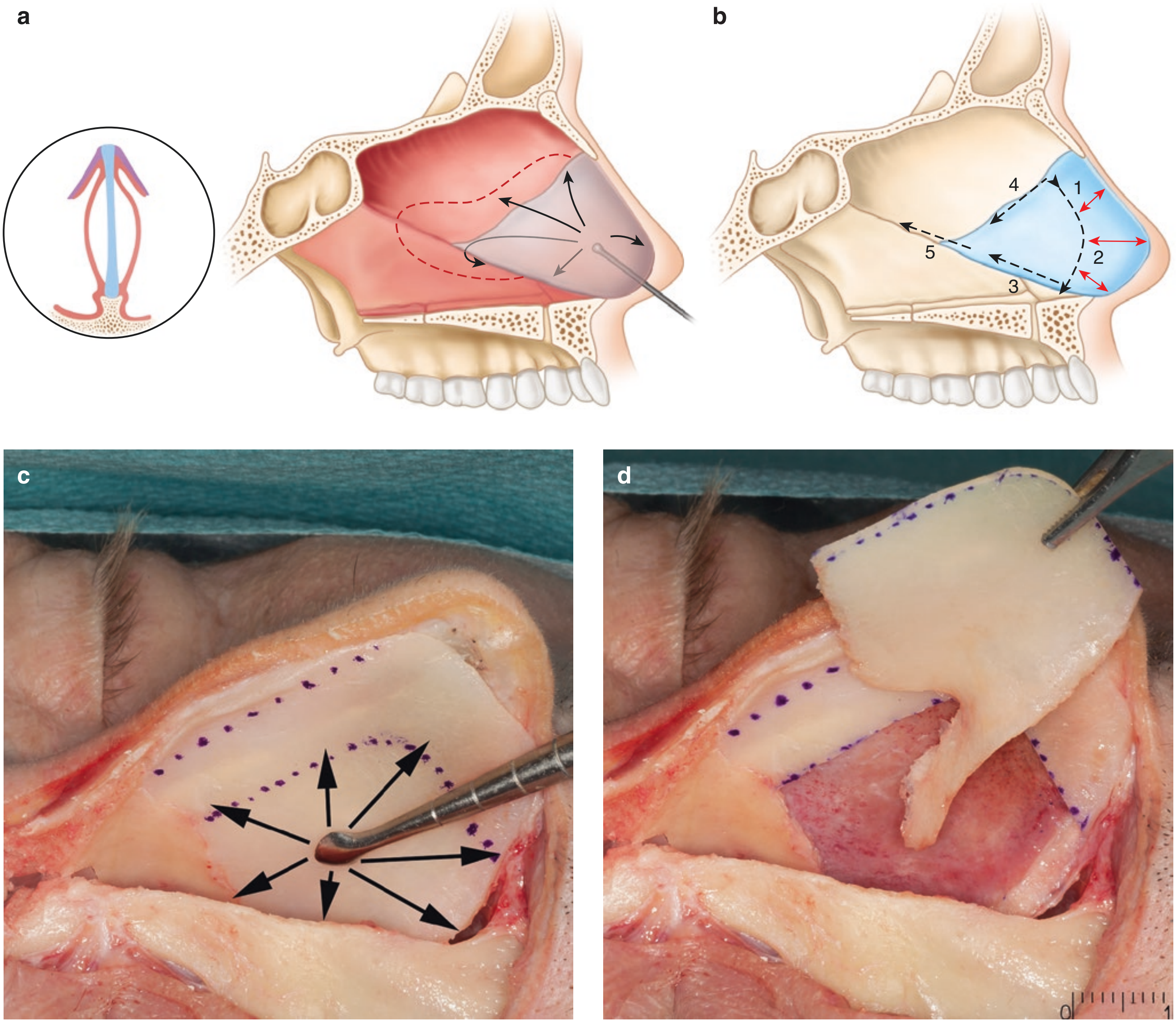


Fig. 4.13 (**a–d**) Mucosal elevation from the septal body and excision of cartilage

The concept of leaving a 10- to 15-mm L-shaped strut for septal support means that there is essentially no difference between a septal harvest for acquiring graft material and excision of a severely deviated septal body (Fig. 4.13). The technical complexity of parallel cuts and crosshatching has become outmoded for most surgeons. The simplistic but effective rule has become "When in doubt take it out." The obligatory corollary is to first assess the overall rigidity of the septal cartilage and to be conservative when the cartilage is flimsy. One should take out only the necessary amount needed to correct the deflection or to obtain sufficient graft material. Although an "L-shaped strut" is frequently referred to, the junction between the dorsal and septal limb should be a broad curve, or even triangular. It should not be a right angle, which is biomechanically weak and easily fractured.

SEPTOPLASTY: BONY RESECTION

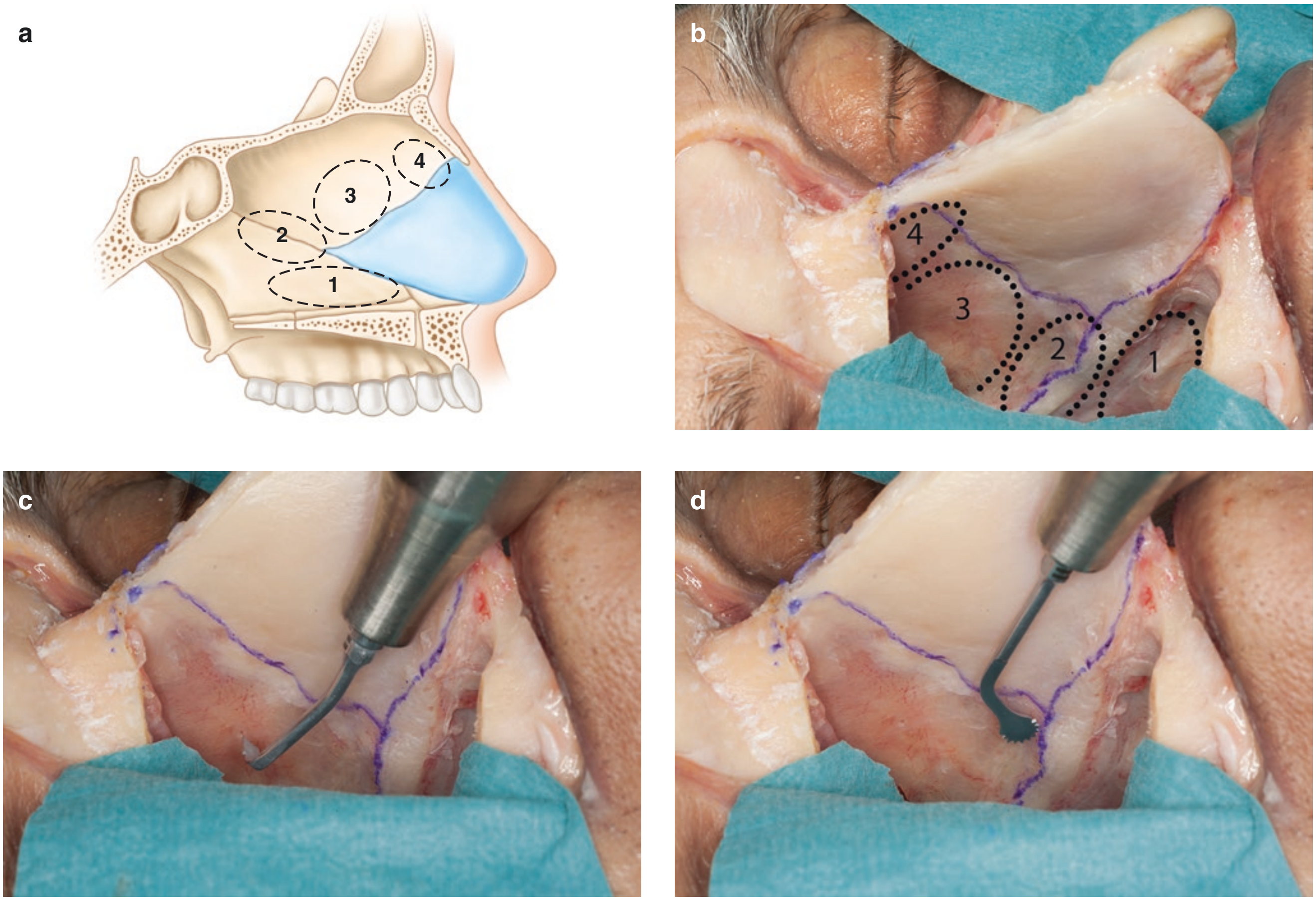


Fig. 4.14 (**a–d**) Posterior bony septal resection: (1) vomer, (2) spur, (3) high dorsal, (4) junctional

Resection of the bony septum is often an obligate necessity that is guided by functional factors and its intrinsic anatomy. Most often, removal of a portion of the bony septum is done following resection of the deviated cartilaginous septum. Sequential resection gives one greater access to the bony septum (Fig. 4.14). Displacement of the vomerine bone becomes very apparent after the base of the cartilaginous septum has been removed (Area 1). A straight, guarded osteotome is used to pry loose the vomerine bone. The most common area of bony resection is the cephalic spur area, which is overlaid by the tail of the cartilaginous septum (Area 2). Sharp resection of the spur is often done with a biting forceps. The most challenging area is resection of high dorsal bony deviations (Area 3). One reason is the anatomical variation in the *bony-cartilaginous junction* beneath the keystone area (Area 4). If one marks the keystone junction dorsally, the cartilaginous septal junction with the bony perpendicular plate varies dramatically, with the cartilaginous septum extending 8–10 mm cephalic to the dorsal junction. One must be careful resecting higher bony deviations, as any twisting of the perpendicular plate of the ethmoid (PPE) can result in disarticulation from the cribriform plate and lead to a CSF leak (Area 3). Therefore, we prefer to use either a Lindemann side-cutting burr or a piezoelectric saw to cut through the thicker bony septum in this area (Gubisch 2017; Gerbault et al. 2016).

SEPTOPLASTY: CAUDAL SEPTAL RELOCATION

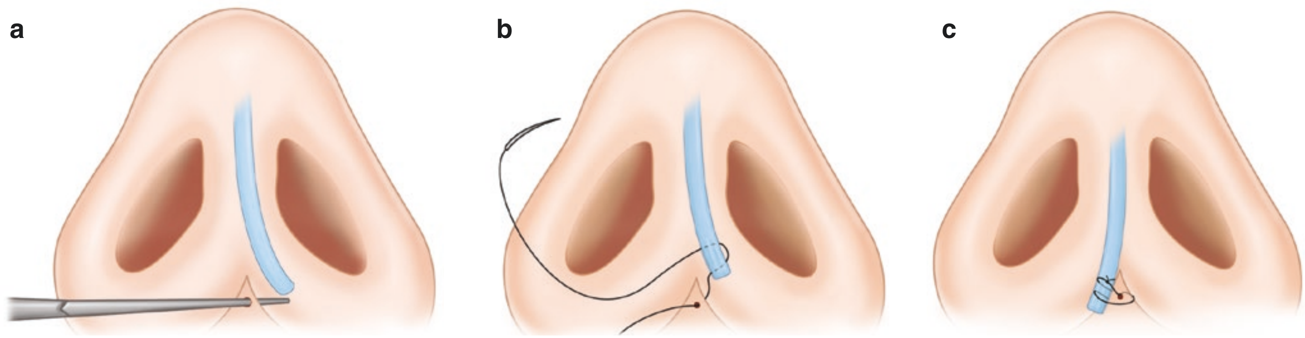


Fig. 4.15 (**a–c**) Caudal septal relocation

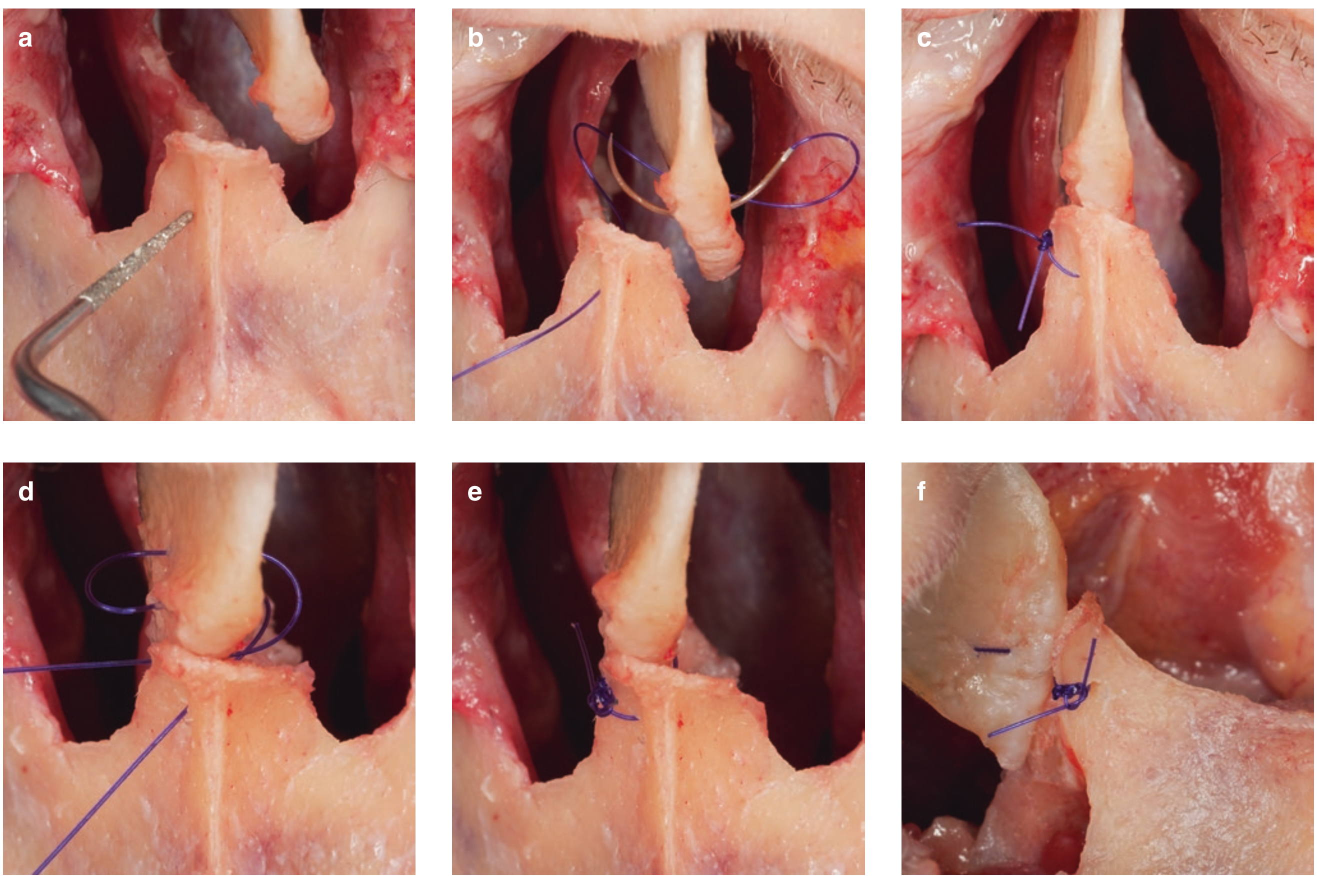


Fig. 4.16 Caudal septal relocation (**a–c**) to the midline and (**d–f**) over the midline

Caudal septal relocation is composed of four basic steps: (1) caudal septal release from the ANS; (2) minimal septum resection for reducing tension; (3) drilling a hole on the opposite side of the ANS to the deviation, using burr, piezo, or needle; and (4) a 4-0 PDS suture fixation (Fig. 4.15). The suturing can vary the position of the septum to the ANS. If a midline alignment is desired, then a classic suturing is done (Fig. 4.16a–c). If the caudal septum must be set on the opposite side of the ANS, then the suturing is modified as seen in Figure 4.16d–f.

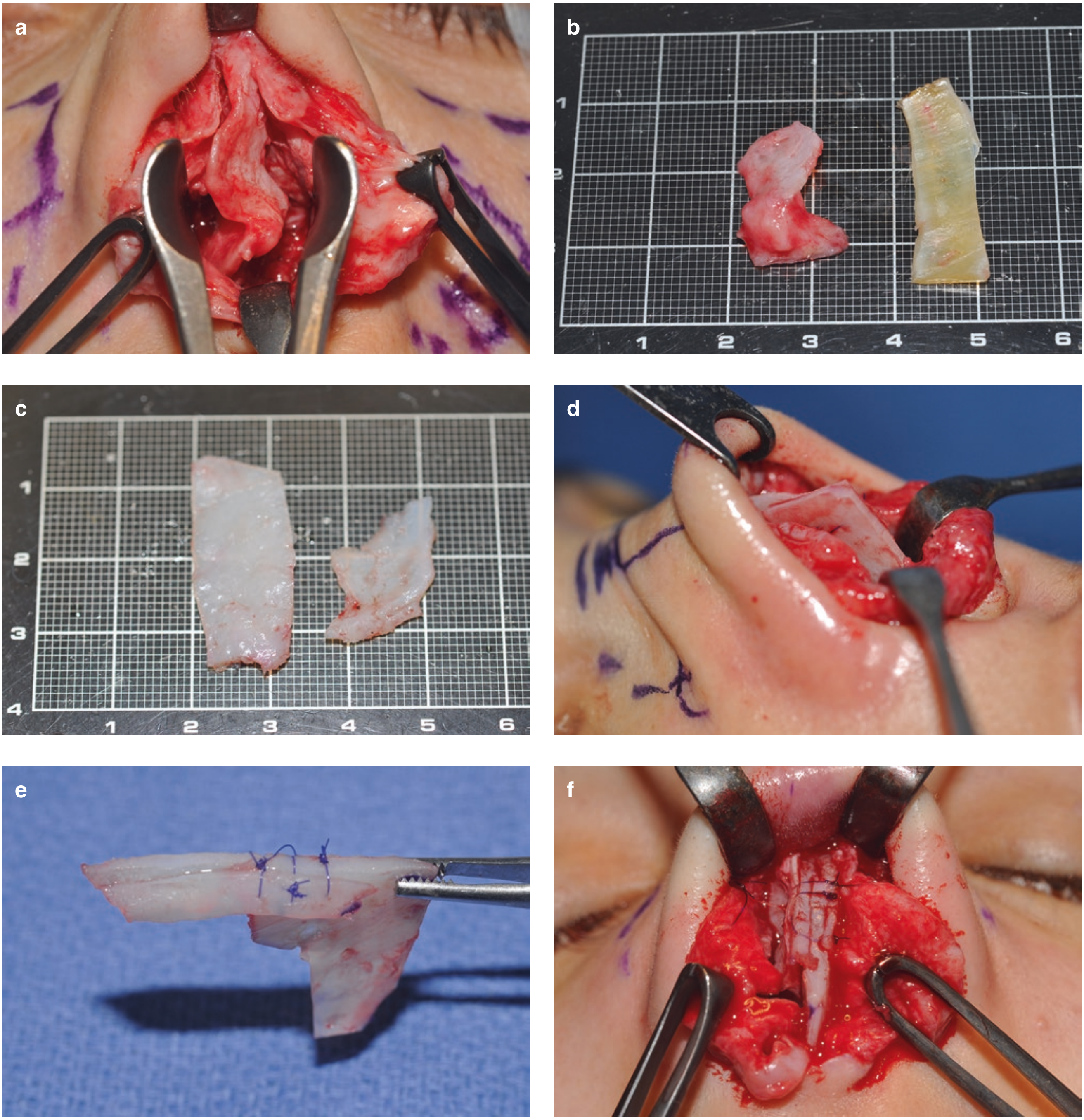


Fig. 4.17 (**a–d**) Caudal septum replacement graft. (**e, f**) Excised caudal septum extended more dorsally in secondary septoplasty

When the structural integrity of the caudal septum is compromised, then one must consider reinforcement or replacement. Overlapping or angled brace grafts can be used to reinforce a weakened or slightly curved caudal septum. Obviously, this graft insertion is most easily done through an open approach. One must consider the added volume of grafts in the critical area. Certainly, reinforcement has the least risk and is the procedure of choice in primary cases. Replacement is often required in posttraumatic or secondary cases, especially when the structural integrity of the caudal septum has been compromised by various incisions and excisions. The replacement graft can range from a "septal graft" (Fig. 4.17a–d) to grafts extended more dorsally (Fig. 4.17e, f) which approaches a "partial" subtotal septoplasty.

SEPTOPLASTY FOR DORSAL DEVIATION

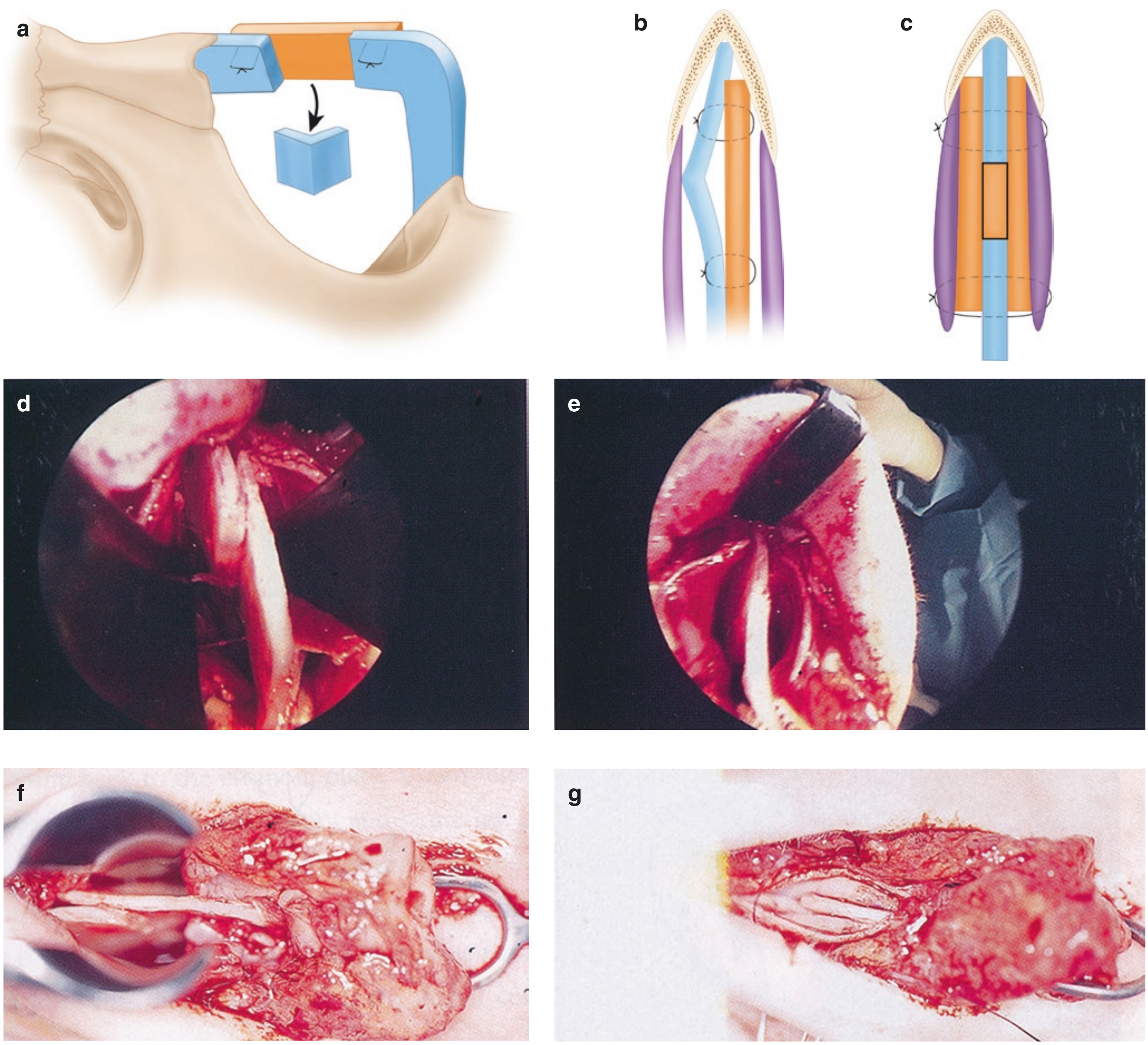


Fig. 4.18 (**a–g**) Cartilaginous dorsal septum straightening

Dorsal septal problems consist of linear or transverse deviations as well as complete division of the dorsal component of the L-shape strut (Fig. 4.18). For transverse deviations or angulations, the ULCs are detached from the septum, allowing evaluation of the location and severity of the dorsal angulation. A spreader graft is placed on the concave side to serve as a brace and maintain structural relationships (Fig. 4.18a, b). The graft is sutured to the septum along the dorsum above and below the deviation. Then the angulation in the septum is incised if possible, and excised only if necessary (Fig. 4.18c). With the dorsum now straight, a spreader graft is placed on the previously deviated side and sutured as a five-layer "sandwich" incorporating the ULCs, spreader grafts, and septum. When a complete division of the L-shape strut is encountered, then total exposure is required (Fig. 4.18d). The septum is brought out to length (Fig. 4.18e), braced with spreader grafts on either side, fixed with #25 needles, and then sutured with 4-0 PDS (Fig. 4.18f, g). If the disjunction involves the bony septum, then drill holes through the nasal bones will be necessary, plus a cerclage type of suspension suture.

SUBTOTAL SEPTOPLASTY

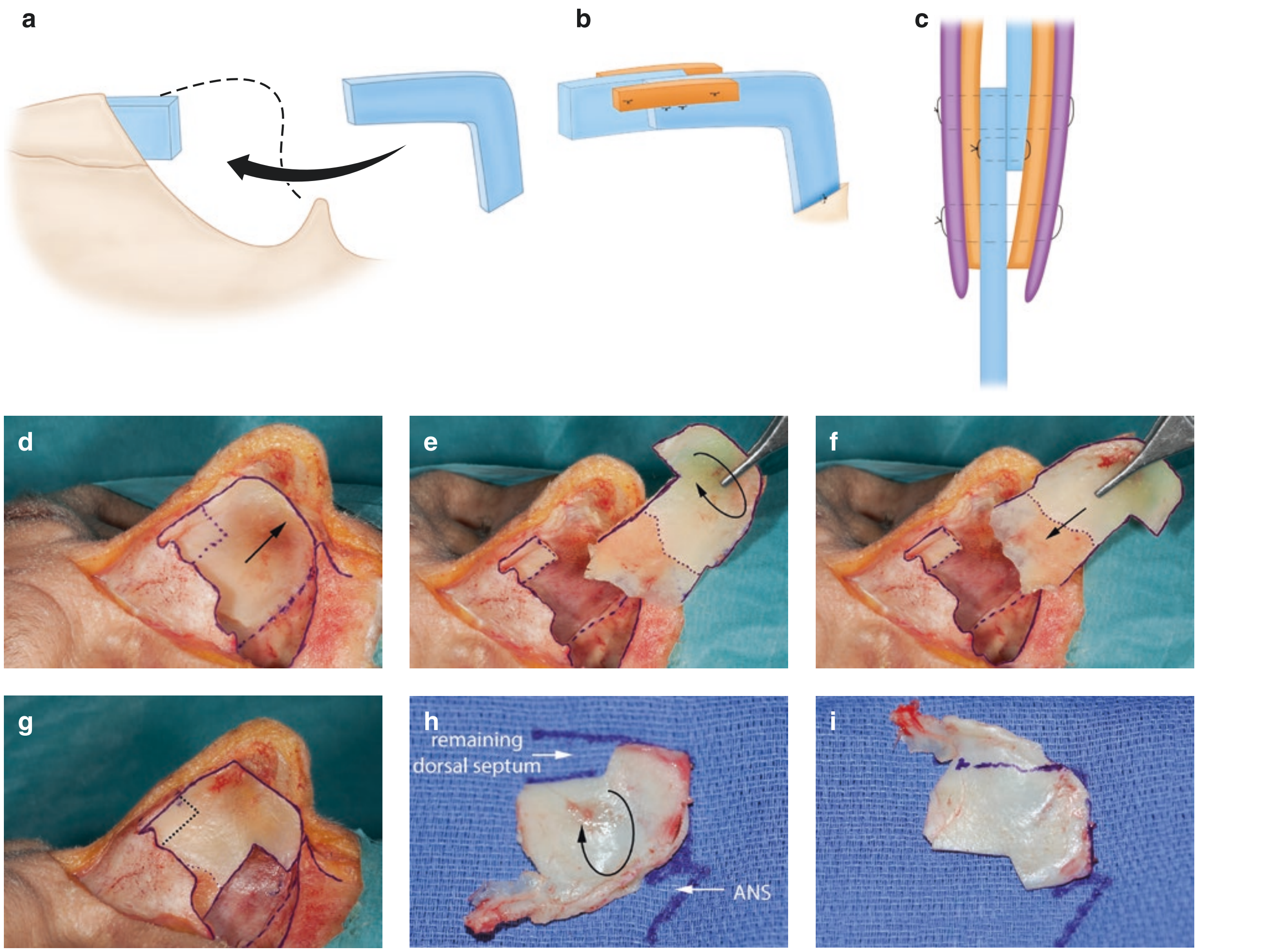


Fig. 4.19 (**a–g**) Subtotal septoplasty scheme. (**h, i**) Shaping of the septum clinically

At first glance, subtotal removal of the cartilaginous septum with reinsertion of a straight L-shape strut seems excessive and fraught with risk, yet the long-term results are excellent and the complications are few (Gubisch 2006; Jugo 1995).

Step #1 Exposure. Extramucosal tunnels are completed and the ULCs are detached from the dorsal septum. A top-down dissection is done beginning on the concave side to expose the body of the septum, followed by a posterior-to-anterior elevation along the vomerine junction and across the caudal septum.

Step #2 Excision. Once the septum is completely exposed, the point of deviation along the dorsal cartilaginous septum is defined. A vertical cut 10 mm in height is made at the deviation point and is extended cephalically, paralleling the dorsum back to the ethmoid plate. The inferior septum is mobilized from the ANS back along the vomerine groove, extending up to the cephalic cut. The entire cartilaginous septum is removed.

Step #3 Shaping the Graft. The cartilage is then placed on a towel and a straight L-shape replacement graft is designed using the previously drawn pattern.

Step #4 Graft Reinsertion. Reinsertion consists of the following steps (Fig. 4.19): (1) The graft is placed on the side opposite the preoperative dorsal deviation. (2) The graft overlaps dorsally with the cephalic septal cartilage stump and is held in place with #25 percutaneous needles. (3) The graft is fixed to the ANS with a 4-0 PDS placed through a drill hole in the ANS and the caudal septum, positioned on the side opposite to the preoperative deviation. (4) The strut is sutured to the dorsal septum at two points with 4-0 PDS. (5) A contralateral spreader graft is added, followed by "sandwich sutures".

TOTAL SEPTOPLASTY

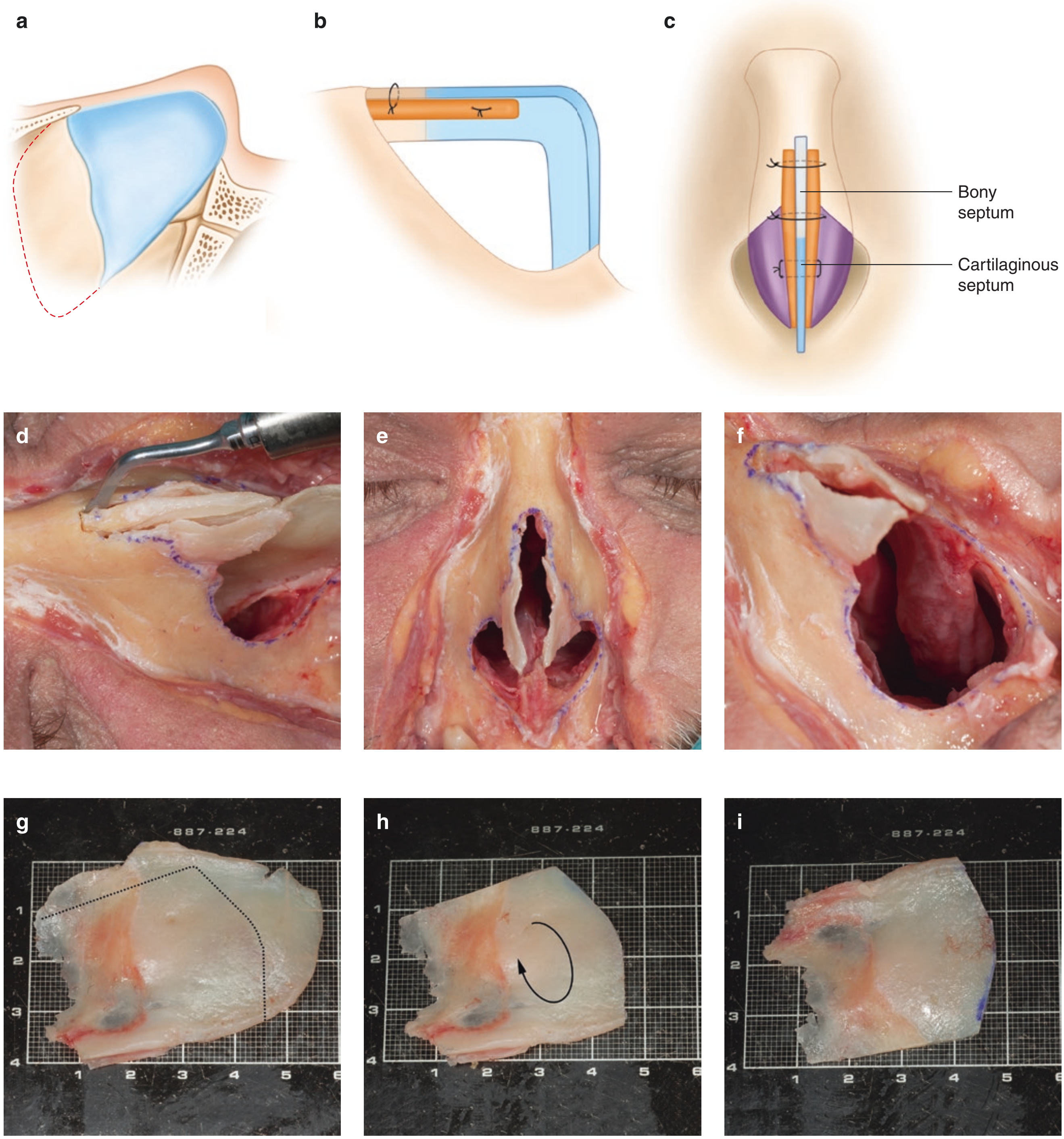


Fig. 4.20 (**a–c**) Total septoplasty. (**d–f**) Excision of the septum. (**g–i**) Septum preparation

The total septoplasty was perfected by Gubisch (2006, 2017), who has done over 2000 cases in the past 25 years. The indication is a severely deviated nose, most frequently in posttraumatic or secondary cases.

Step #1 Exposure. An open approach is preferred. The anterior septum is exposed in a top-down fashion after detachment of the ULCs. A posterior tunnel is made from the premaxilla in the subperiosteal plane, and the two tunnels are connected.

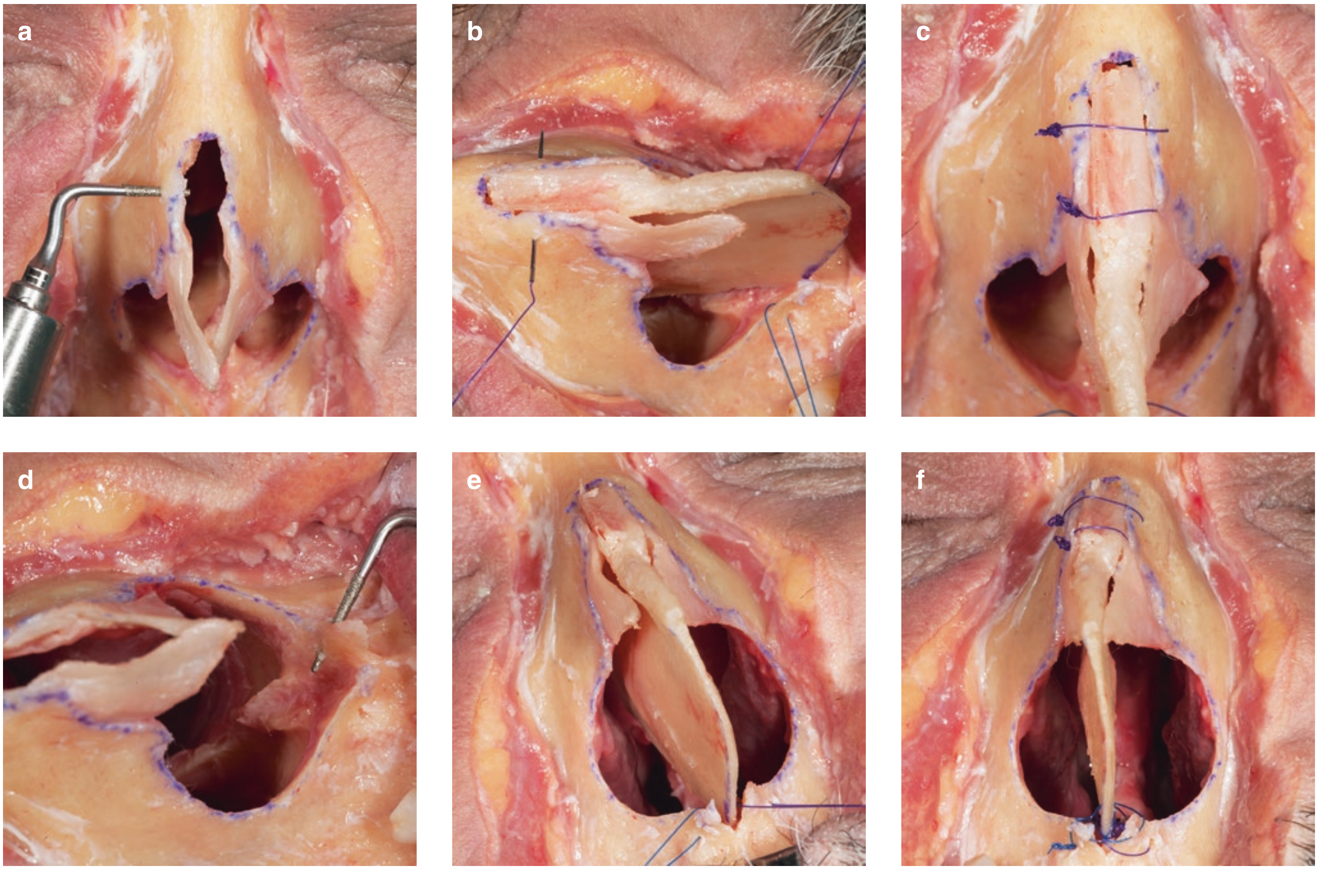


Fig. 4.21 Total septoplasty. (**a–c**) Dorsal fixation. (**d–f**) ANS fixation

Step #2 Removal of the septum. In contrast to the subtotal septoplasty, where just the cartilaginous septum is excised, the total septoplasty includes a significant portion of the bony septum (Fig. 4.20a–c). We prefer a piezoelectric saw to cut paramedian osteotomies, followed by a downward cut through the bony septum and then vertical down into the vomer. The septum is then freed out of the maxillary crest, back to the vertical cut.

Step #3 Preparing the L-shape strut. It is critical to create a straight septal plate with a rigid anterior and caudal border (Fig. 4.20d–f). Although many cartilaginous deviations straighten following removal, creating a striaght graft can be challenging. Burring of prominences and splinting of fracture lines are often necessary. Thin, perforated pieces of perpendicular plate of ethmoid are often used. Usually, spreader grafts are sutured to the graft to help fill the bony vault defect and reestablish the cartilaginous vault.

Step #4 Dorsal fixation. In most cases, drill holes are made in the nasal bones to allow two cerclage or criss-cross sutures of 4-0 PDS to be inserted (Fig. 4.21a–c). The graft is placed into the defect and the aligment is fixed with #25 needles through the ULC. At this point, the bony fixation is done, followed by a five-suture cartilaginous vault fixation.

Step #5 ANS fixation. A piezo drill is used before the graft is inserted to place drill holes on either side of the ANS and to create a longitudinal grove (Fig. 4.21d–f). Sutures of 4-0 PDS are passed through the holes from both sides. Once the dorsal fixation is completed, a two-suture fixation is done to fix the graft in the midline at the ANS, similar to the reins of a horse.

SEPTOPLASTY: DEVIATION (CASE STUDY)

Analysis: A 17-year-old girl presented with the complaint of a crooked nose and nasal obstruction that was worse on the left side. There was no history of significant nasal trauma. Examination indicated a marked septal deviation to the left, manifested both dorsally and in the caudal septum—essentially a straight-line deviation (Fig. 4.22). Bony asymmetry was apparent on the concave left side, convex right side, and marked hypoplasia of the left maxilla. The soft tissue envelope was extremely thin.

Operative Technique:

1. Harvest of deep temporal fascia. Open approach with deep dissection.
2. Exposure of the septum through a right transfixion suture. No alar excision.
3. Minimal dorsal reduction (1.5 mm). Harvest of the septal body. Bilateral spreader grafts (R 2.2, L 1.2).
4. Relocation of caudal septum L to R, an 8-mm movement.
5. Medial oblique osteotomies. R: double level osteotomies; L: low-to-low.
6. Insertion of columellar strut. Tip suture: DE. Fascia graft to dorsum.

Commentary: At 2 years postop, the straight-line septal deviation has been corrected by caudal septal relocation. The changes in the columellar and nostril shape are dramatic (Fig. 4.23). In addition to correcting the septal deviation, the straightness of the nose is due to changes in the osseocartilaginous vault. First, the double-level osteotomy on the right side corrected the intrinsic convexity of the right lateral bony wall. Second, the cartilage vault was equalized with asymmetric spreader grafts (R 2.2 mm, L 1.2 mm).

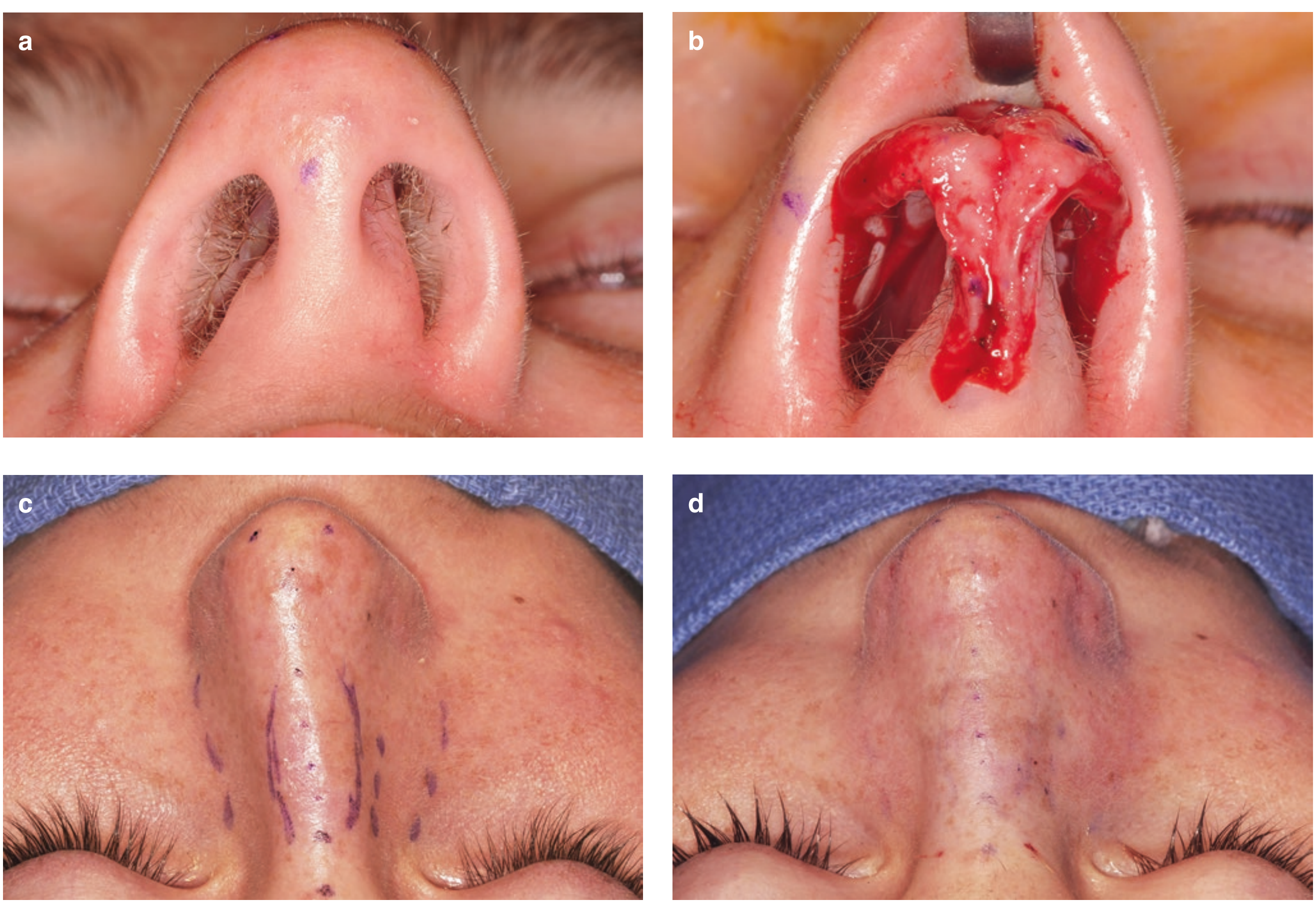


Fig. 4.22 (**a–d**) The crooked nose

SEPTOPLASTY: DEVIATION (CASE STUDY)

Fig. 4.23 (**a–j**) Patient in case study, before (*left*) and 2 years after (*right*) surgery to correct her crooked nose

SUBTOTAL SEPTOPLASTY (CASE STUDY)

Analysis: A 28-year-old woman presented with severe nasal obstruction and no history of prior nasal trauma. A reverse C-shape septal deviation was present. The caudal septum was at a 90-degree angle, blocking the right airway, and the body was deviated into the left airway. A “double shift” septal replacement was planned, in which the caudal septum would be placed on the left and the dorsal component on the right, thus reversing the presenting deviation (Fig. 4.24).

Operative Technique:

1. Open approach. Dorsal smoothing with minimal resection.
2. Bidirectional septal exposure via a right transfixion incision and tip split.
3. Subtotal septal resection. Creation of a straight septal replacement graft.
4. Transverse and low-to-low osteotomies.
5. Insertion of a columellar strut. Tip suturing: CS, DC, DE.
6. Nostril sill excision followed by insertion of alar rim structure grafts.

Commentary: The distal third of this septum was essentially a right angle that blocked both airways, with loss of tip support. The face was asymmetric, with facial deviation to the right (Fig. 4.25). A subtotal septal excison (the entire cartilaginous septum, with preservation of bony septal support) provided sufficent material to reconfigure a straight L-shape replacement graft. A columellar strut graft ensured that the tip would project above the dorsal profile line established by the replacement graft.

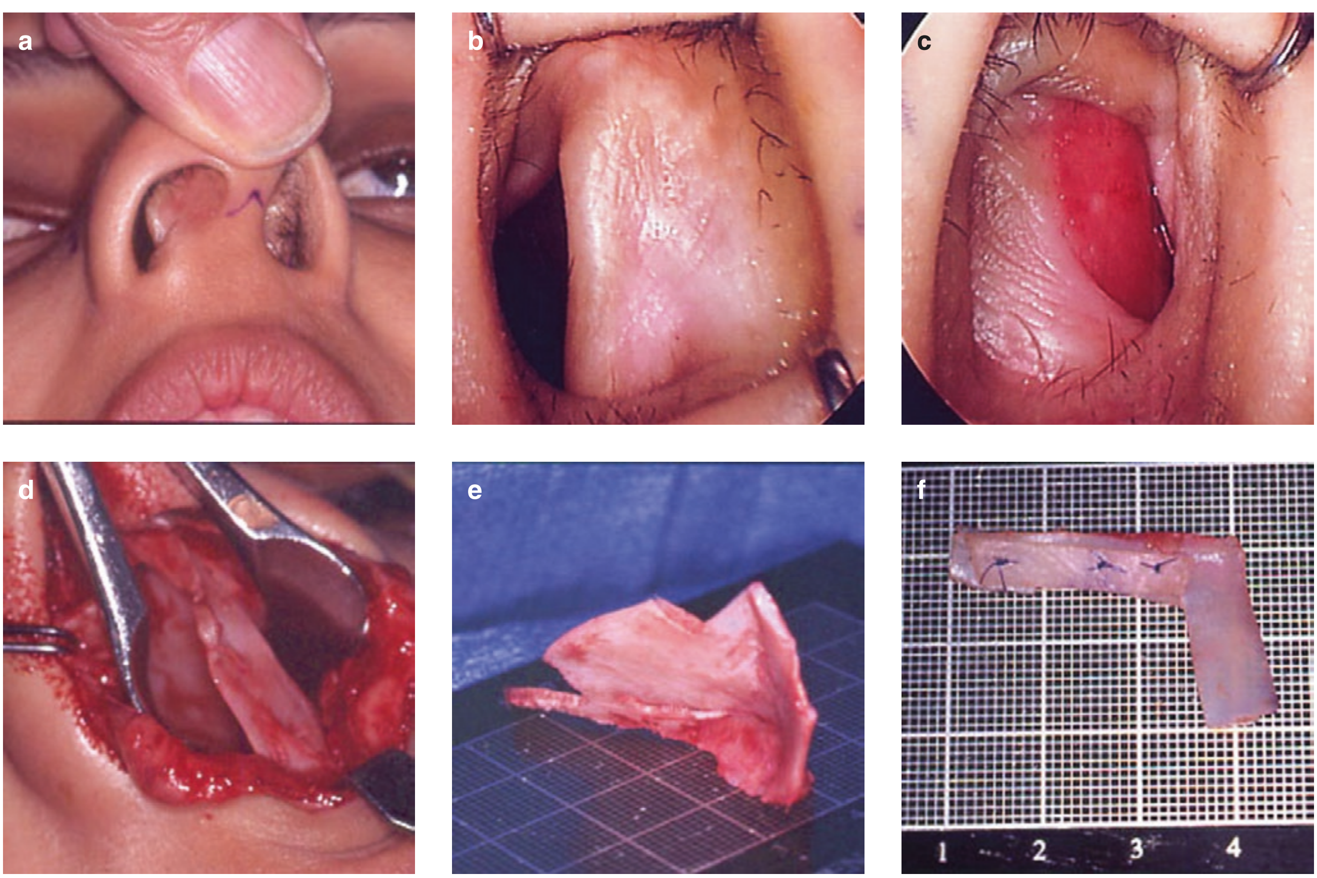


Fig. 4.24 (**a–f**) Subtotal septoplasty

SUBTOTAL SEPTOPLASTY (CASE STUDY)

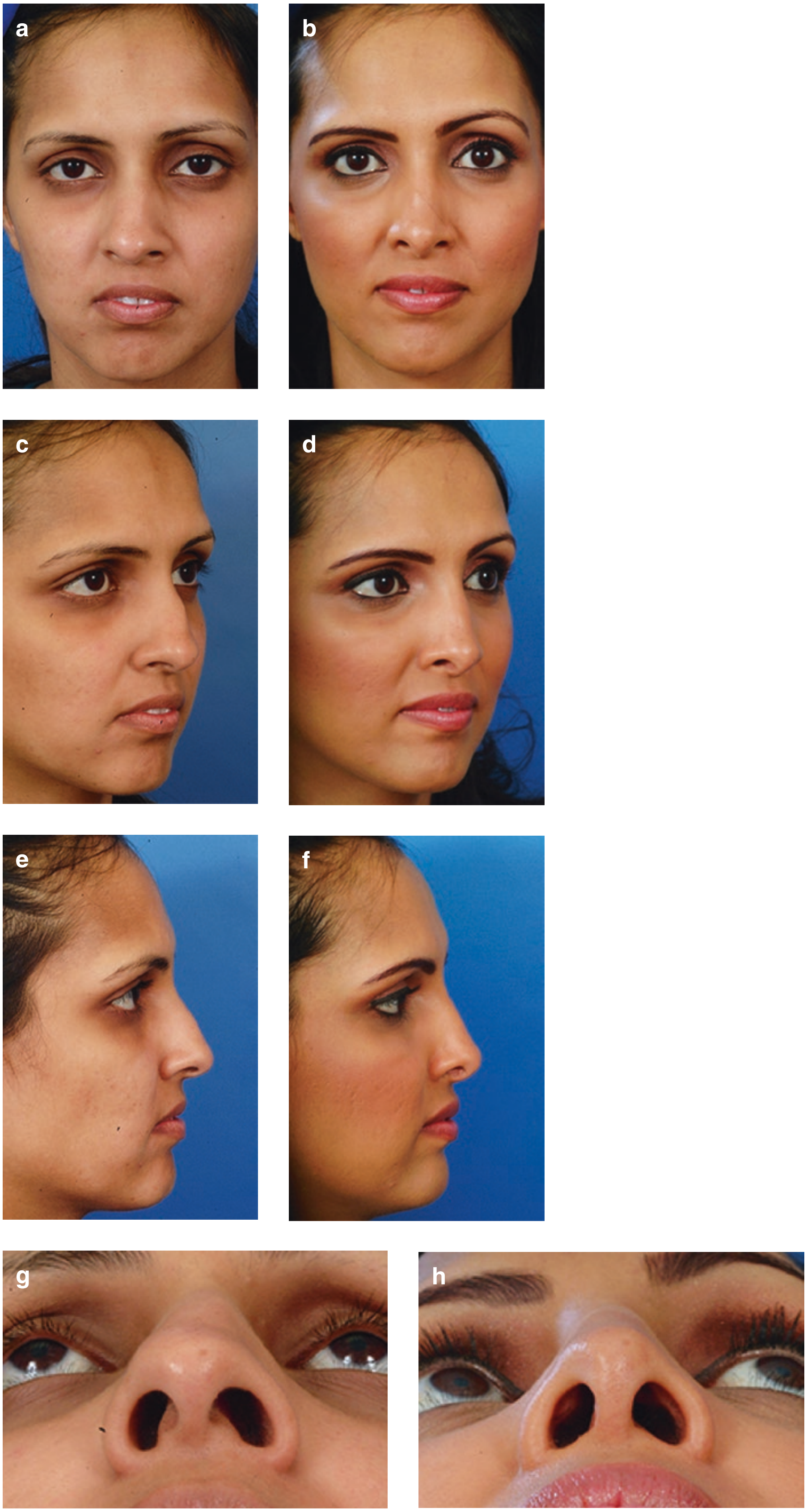


Fig. 4.25 (**a–h**) Patient in case study, before (*left*) and 1 year after (*right*) surgery to correct septal deviation

SEPTAL SADDLE NOSE

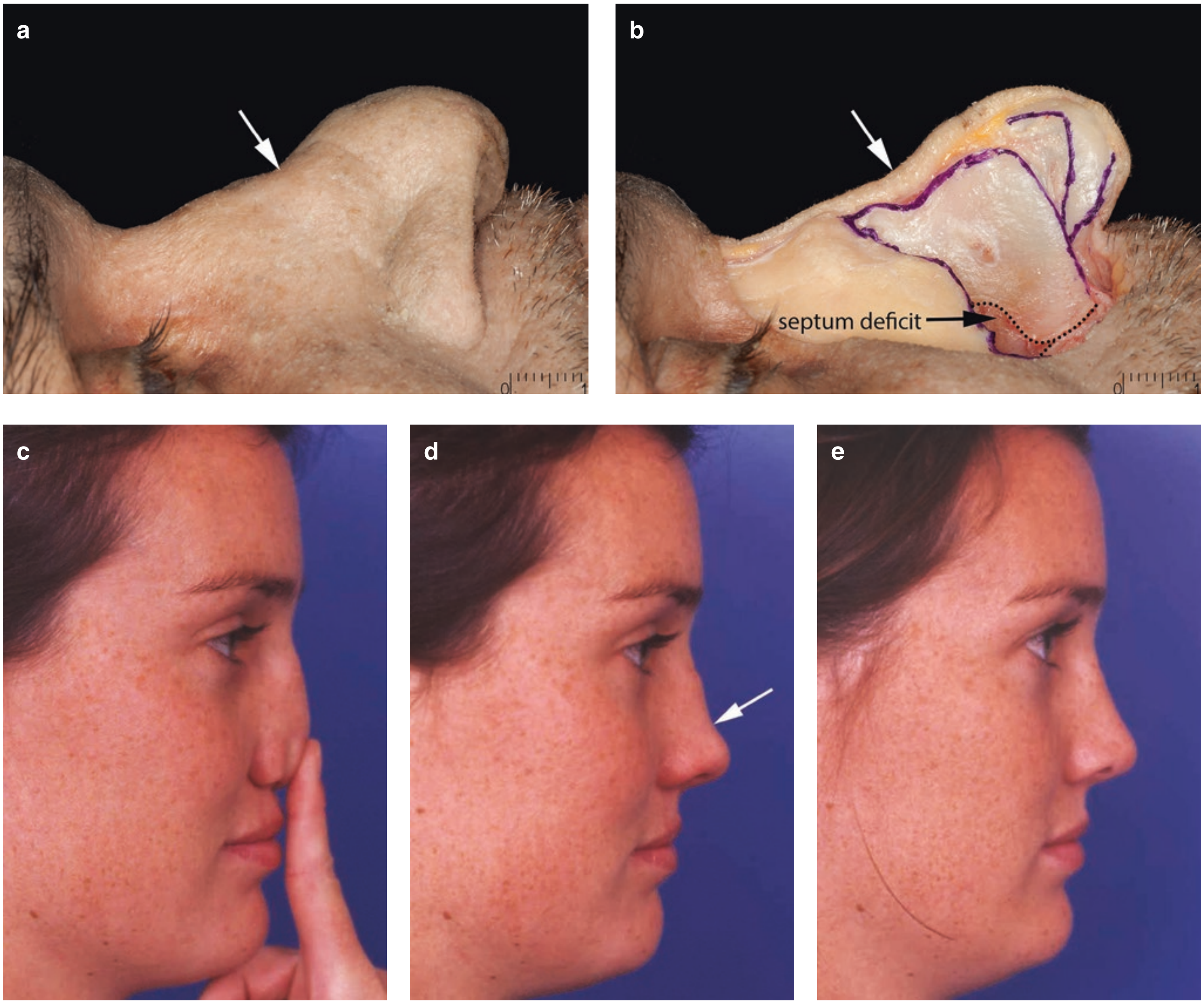


Fig. 4.26 (**a–e**) Septal saddle nose anatomy and clinical example

A *septal saddle nose* consists of a subset within the *saddle nose* universe and is defined by the combination of a dorsal depression and inadequate septal support. Septal stability is determined by pressing the nasal tip inward: If the tip remains supported, then septal support is adequate, but if the tip compresses against the premaxilla, then the support is inadequate (Fig. 4.26). Restoration of septal support can range from a standard extended septocolumellar strut to a distal L-shape replacement graft or a complex rib reconstruction with extended spreader grafts and a septal extension graft (Daniel 2007) (Fig. 4.27).

SEPTAL SADDLE NOSE

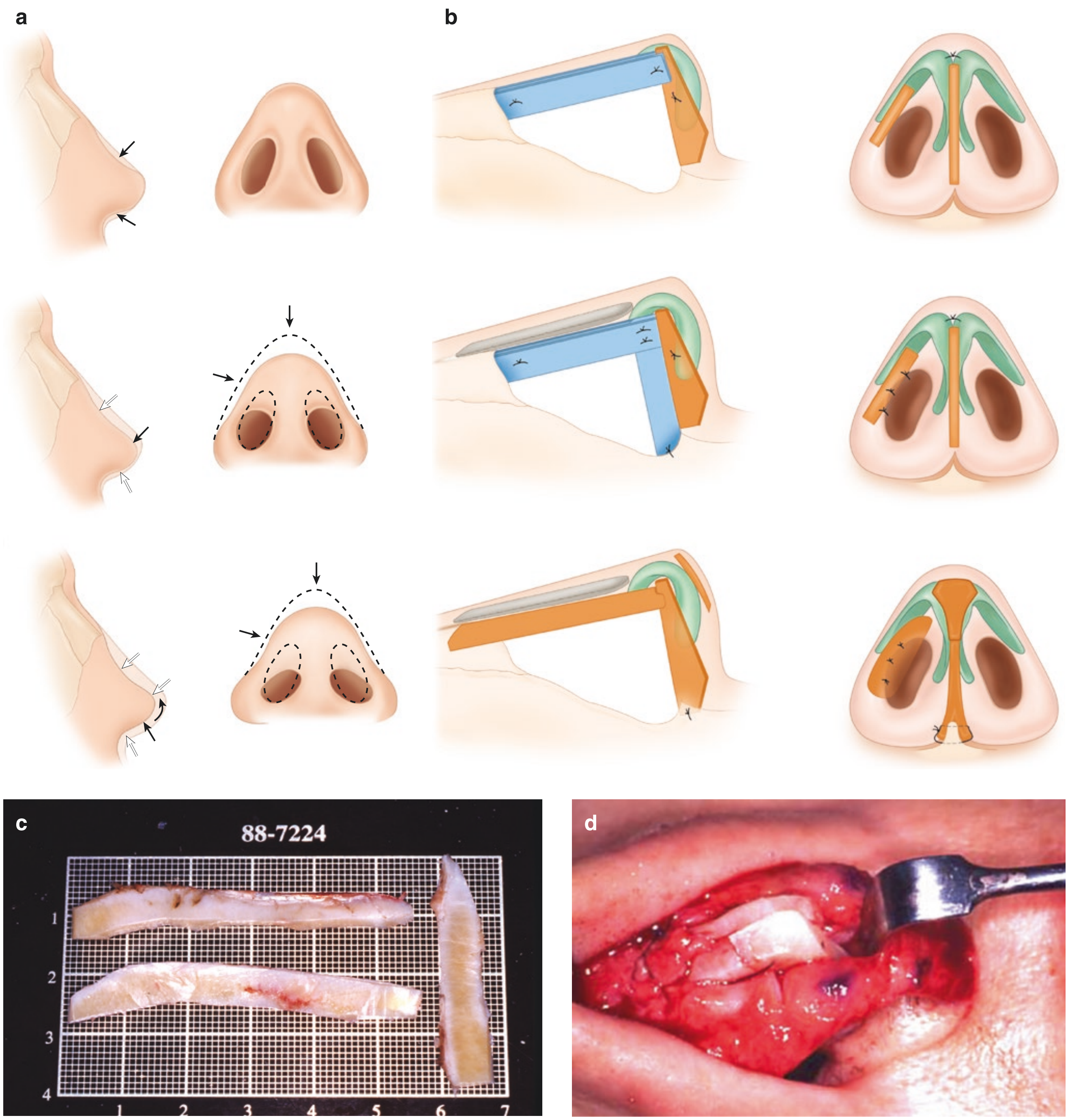


Fig. 4.27 (**a**) Classification of septal saddle deformities. (**b**) Operative treatment. (**c, d**) Grade I deformity corrected with extended spreader grafts and a septal strut with a "step-off" dorsal fixation

SEPTAL SADDLE (CASE STUDY)

Analysis: A 37-year-old man was referred for correction of his progressive saddle nose 1 year following a prior septoplasty. The history was quite interesting, as he had developed a fungal infection (*Aspergillus niger*) of the septum requiring an incision and drainage at 6 weeks postop. Antibiotic therapy successfully controlled the infection, and there was no septal perforation. Analysis shows a typical tripartite saddle nose deformity: (1) saddling of the dorsum, (2) retraction and flattening of the columella, and (3) arch retraction of the alar rims.

Operative Techniques:

1. Harvest of a portion of the 8th rib. Harvest of deep temporal fascia (Fig. 4.28).
2. Open approach to nose. No septal exposure other than paraseptal pockets for spreader grafts.
3. Insertion of extended spreader grafts. Suture fixation to the nasal bone through drill holes.
4. Septal strut anchored to ANS and between spreader grafts.
5. Insertion of a columellar strut to gain tip projection. Addition of a small shield-shape tip graft.
6. Placement of a small dorsal diced cartilage in fascia (DC-F) graft to restore his preoperative "dorsal bump".

Commentary: Because major structural support would be necessary to overcome the contracted mucosa, rib cartilage was harvested at the beginning of the operation. Use of the *composite reconstruction* technique allowed the L-shaped septum to be replaced, followed by an aesthetic contour. Instead of supporting the alar cartilages onto a septal extension graft, a separate columellar strut was used, which allowed the tip to be mobile rather than rigid. At 1 year postop, the nose is structurally supported with strong dorsal lines, especially apparent on oblique view (Fig. 4.29).

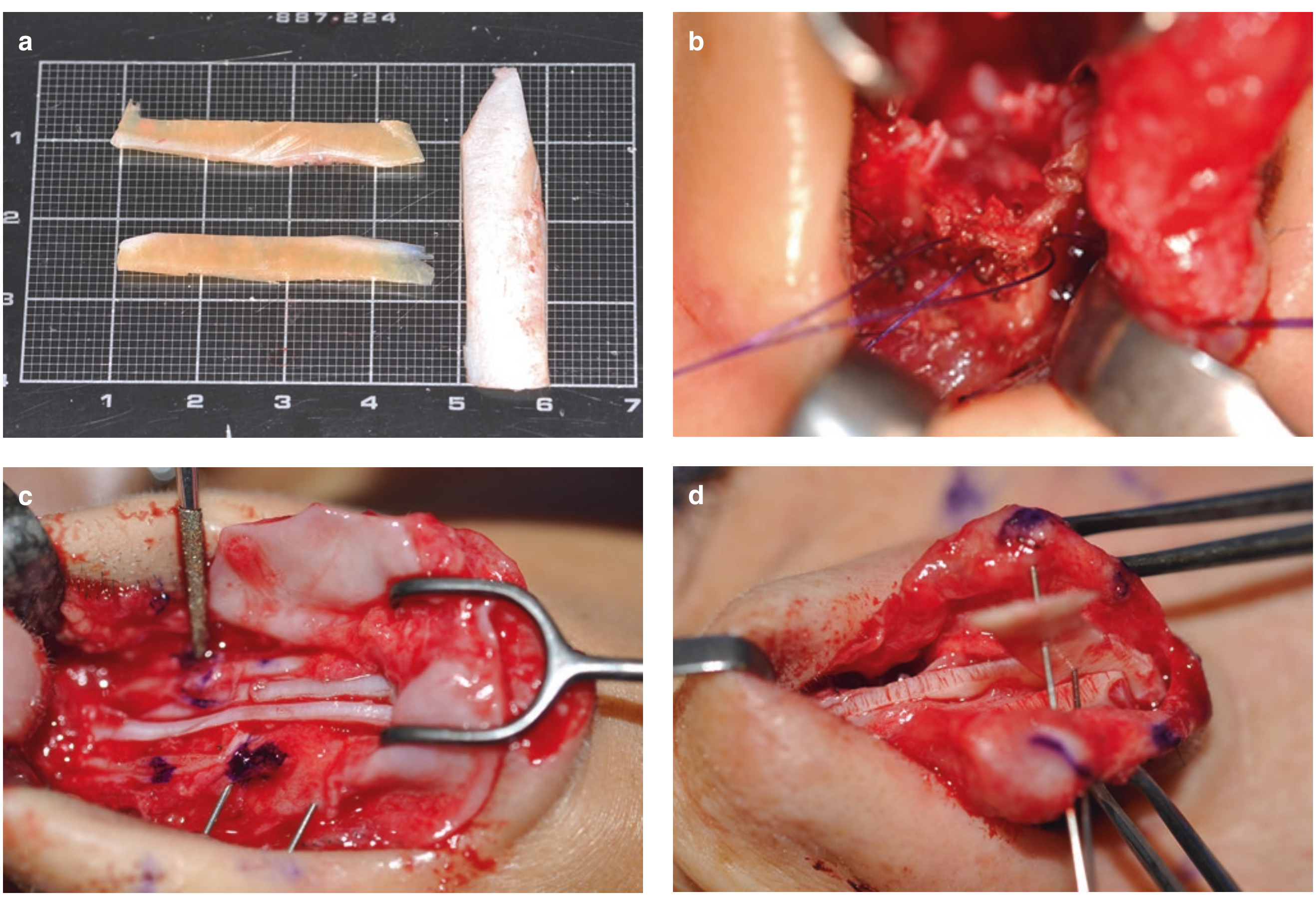


Fig. 4.28 Technique of septal replacement. (**a**) Extended spreader graft and septal strut. (**b**) ANS fixation with double sutures. (**c**) Drill holes through nasal bones. (**d**) Fixation of septal strut between spreader grafts

SEPTAL SADDLE (CASE STUDY)

Fig. 4.29 (**a–h**) Patient in case study, before (*left*) and 1 year after (*right*) composite reconstruction surgery to correct his progressive saddle nose

TURBINATES

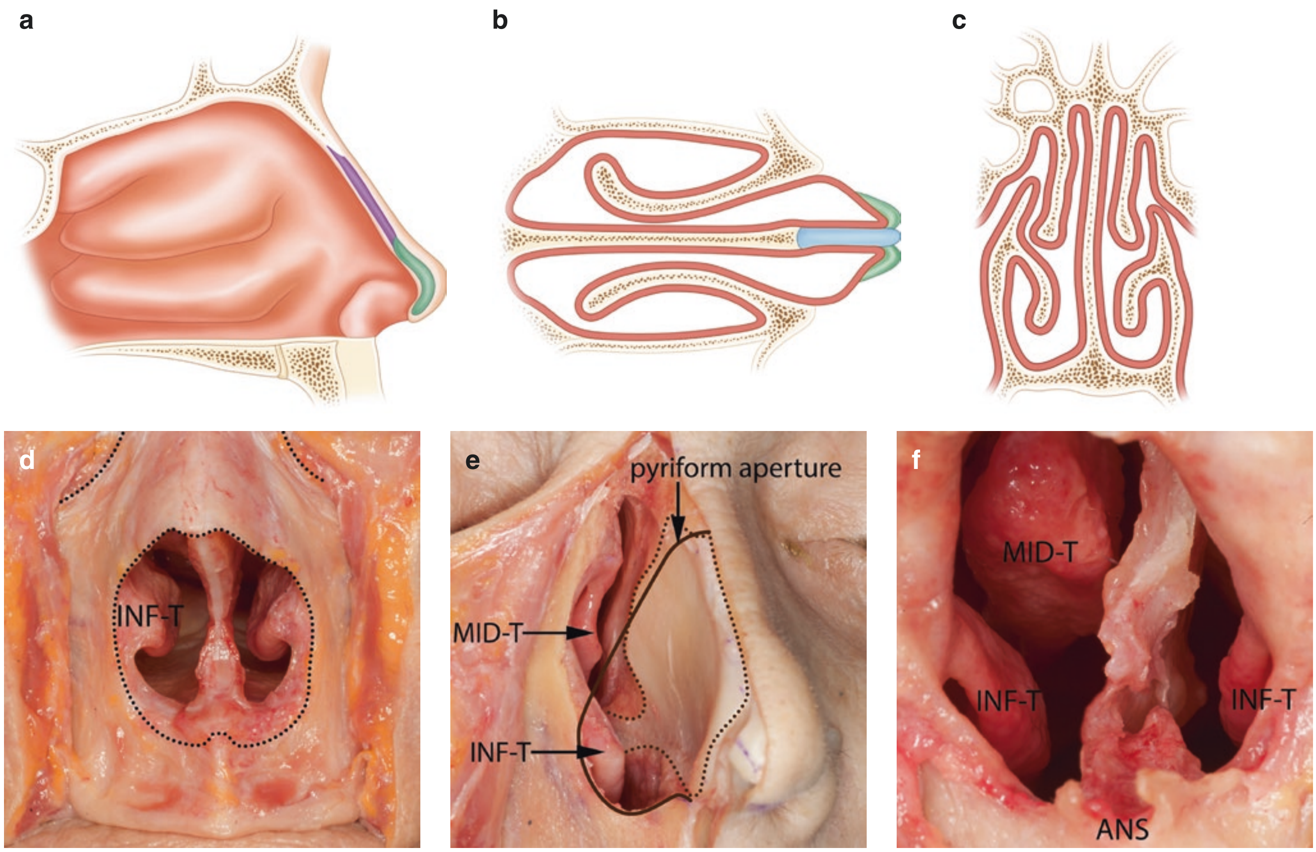


Fig. 4.30 (**a–c**) Turbinate anatomy. (**d**) at the level of the pyriform aperture (*dotted line*) one can see only the inferior turbinate (INF-T), (**e**) Following removal of the bony vault, one can see the relationship between the inferior and middle (MID-T) turbinates. (**f**) Bullous middle turbinate associated with contralateral displacement of the bony septum

The inferior turbinate is a dynamic structure, which diverts nasal air flow and provides primary resistance. The head of the inferior turbinate, which is quite large (14 mm in height) and extremely dynamic, is located in the critical internal valve area (Fig. 4.30). The inferior turbinate is closest to the septum in its midportion before diverging away from the septum posteriorly. If the posterior obstruction is due to simple medial displacement of the inferior turbinate, then a lateral outfracture is done. Inferior turbinectomy is performed in three groups of aesthetic patients: (1) unilateral compensatory hypertrophy associated with septal deviation, (2) chronic bilateral hypertrophy, and (3) preventive resection.

Outfracture In most cases, we perform an outfracture of the inferior turbinates (Fig. 4.31a, b). The Boies elevator is inserted vertically in the recumbent patient to parallel the full length of the inferior turbinate. As noted by Buyuklu et al. (2009), outfracture can be effective, with documented improvement at 9 months postop on CT scan.

Submucosal Coblation Coblation ("controlled ablation") occurs by a non-heat-driven process of soft tissue dissolution using bipolar radiofrequency energy (Fig. 4.31c, d). In contrast to an electrocautery probe with a temperature of 400–600 °C, the coblation wand is at 40–70 °C. There is minimal collateral damage, as "dissolution" is due to vapor film pulsation. Clinical studies have shown persistent clinical improvement (Bhattacharyya and Kepnes 2003).

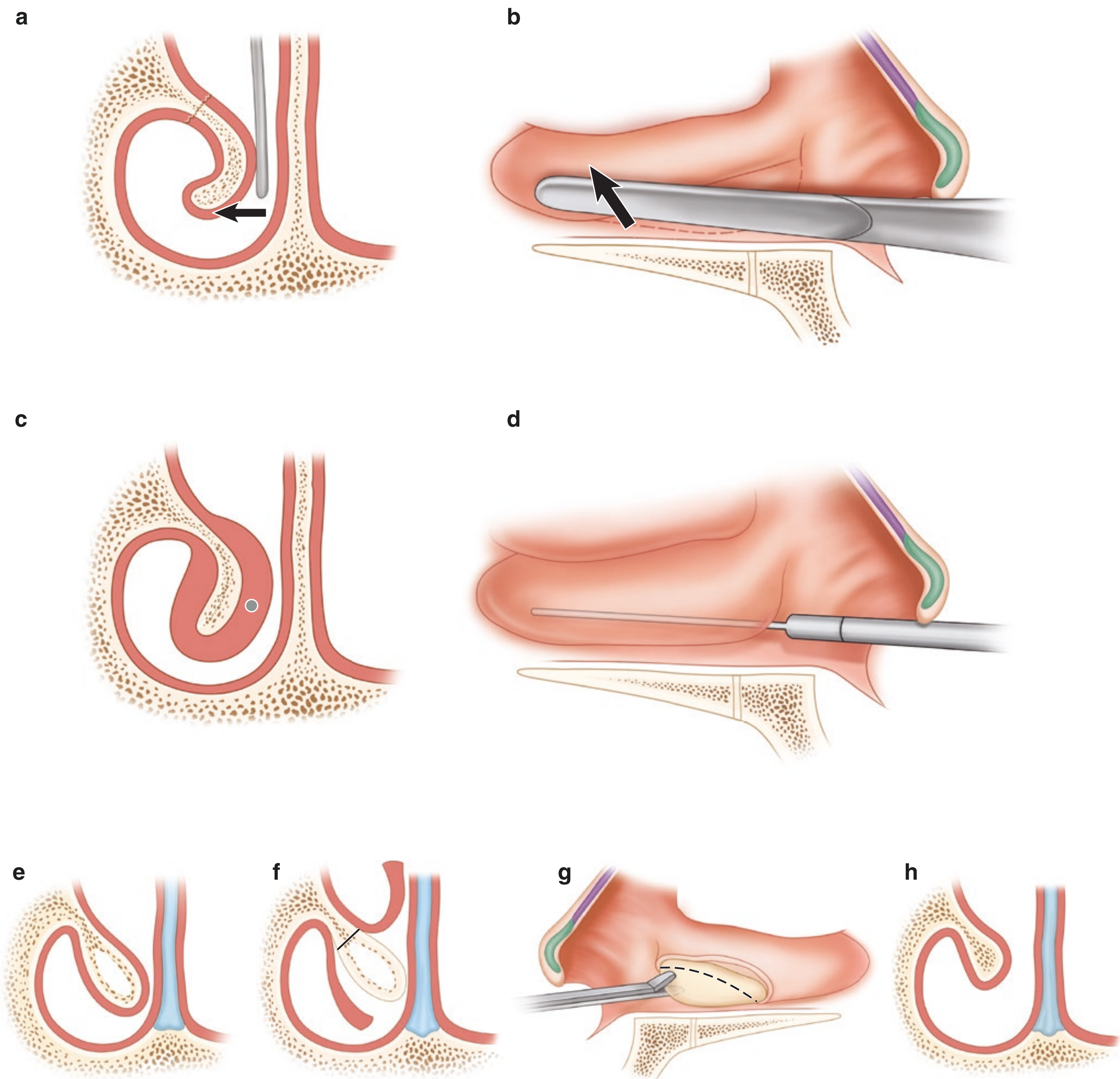


Fig. 4.31 Treatment of obstruction by the inferior turbinate. (**a, b**) Outfracture. (**c, d**) Submucosal coblation. (**e–h**) Submucosal resection

Submucosal Resection The head of the inferior turbinate is injected with 1–2 cc of local anesthesia. As modified from Mabry (1988), an incision is made in the head of the turbinate and the mucosa is elevated over a distance of 2 cm (Fig. 4.31e–h). Then using a modified Gruenwald forceps, the hypertrophic glandular and bony tissue is excised submucosally. The mucosa is then closed with one or two 5-0 plain catgut sutures.

In all cases, internal Doyle splints are used. There are three variations: (1) a silastic sheet without side tubes for turbinectomy alone, (2) a silastic sheet with side tubes for turbinectomy and concomitant septal correction, and (3) silastic sheet with gelfoam for extensive turbinectomy and most males.

TURBINECTOMY (CASE STUDY)

Analysis: A 17-year-old girl complained of nasal obstruction. She had been evaluated (CT scan) by her otolaryngologist, but also wanted her nasal appearance improved. The CT scan revealed a severe septal deviation to the left and a concha bullosa on the right side (Fig. 4.32). The caudal septum was so deviated that it displaced the philtral columns. Externally, the nose was deviated to the left and the face was deviated to the right (Fig. 4.33). The right lateral bony wall measured 26 mm, and the left wall was 21 mm.

Operative Technique:

1. Open approach with moderate soft tissue excision.
2. Reduction of right middle turbinate, using incision, bony crush, and medial displacement. Coblation of inferior turbinates.
3. Dorsal reduction (B 0.5, C 4.0).
4. Septoplasty: body resection, caudal septal relocation L to R, resection of left wing of nasal spine.
5. Medial oblique osteotomies. L–L osteotomy on L. Low intermediate osteotomy at 21 mm on R, followed by an L-L.
6. Placement of a 2-mm wide spreader graft on the right, with none on the L.
7. Insertion of a columellar strut. Tip sutures: CS, DC, ID, DE, TP. Folded tip refinement graft.

Commentary: When there is a severe septal deviation, it is common to have a concha bullosa on the side opposite the septal deviation. Reduction of the middle turbinate is followed by medial displacement to avoid blocking the ostia of the sinus. The septum was straightened, followed by asymmetric osteotomies and unilateral placement of a spreader graft. It must be emphasized that *nasal straightness* is more than *septal straightness* and requires management of the asymmetric osseocartilaginous vault.

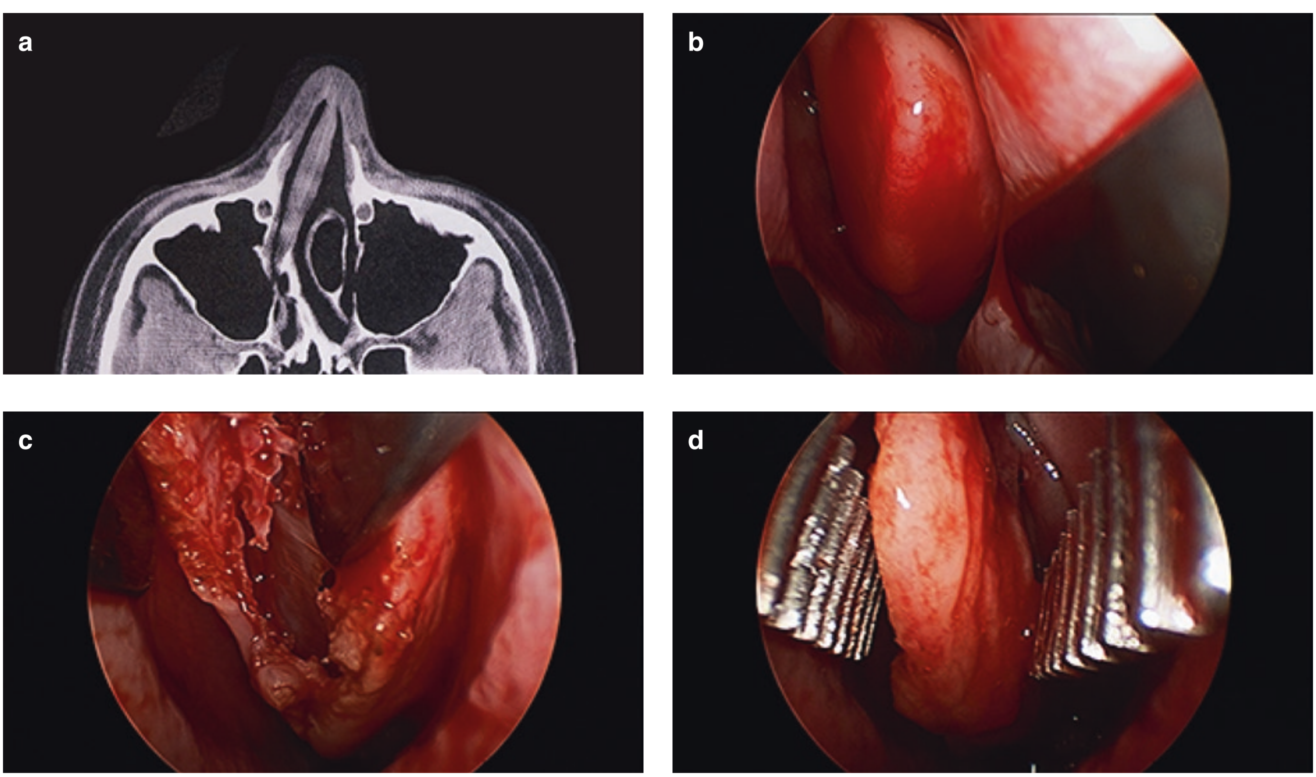


Fig. 4.32 (**a–d**) Treatment of concha bullosa

TURBINECTOMY (CASE STUDY)

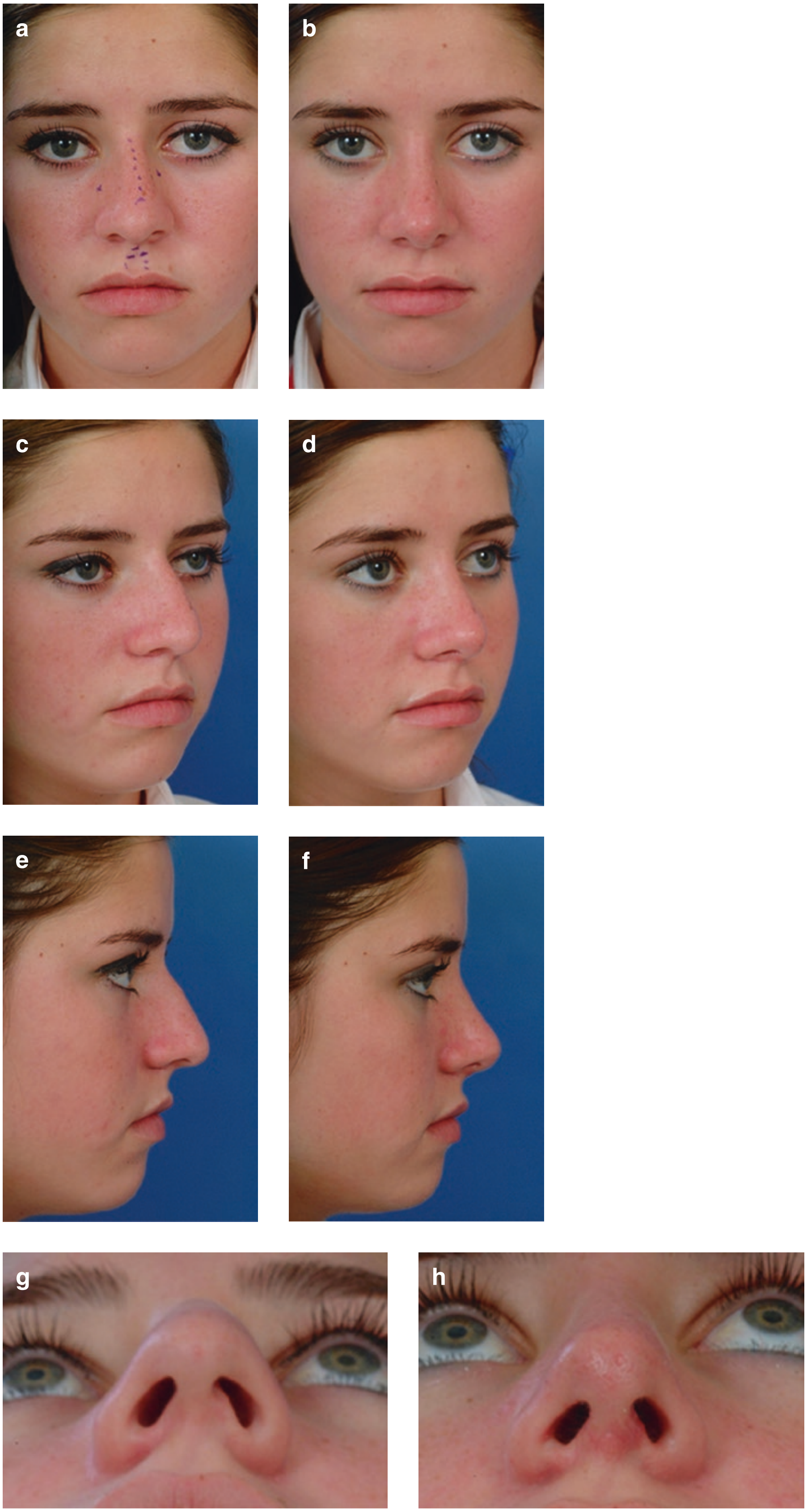


Fig. 4.33 (**a–h**) Patient in case study, before (*left*) and after (*right*) turbinectomy to correct concha bullosa and septal deviation

NASAL VALVES: EXTERNAL VALVE

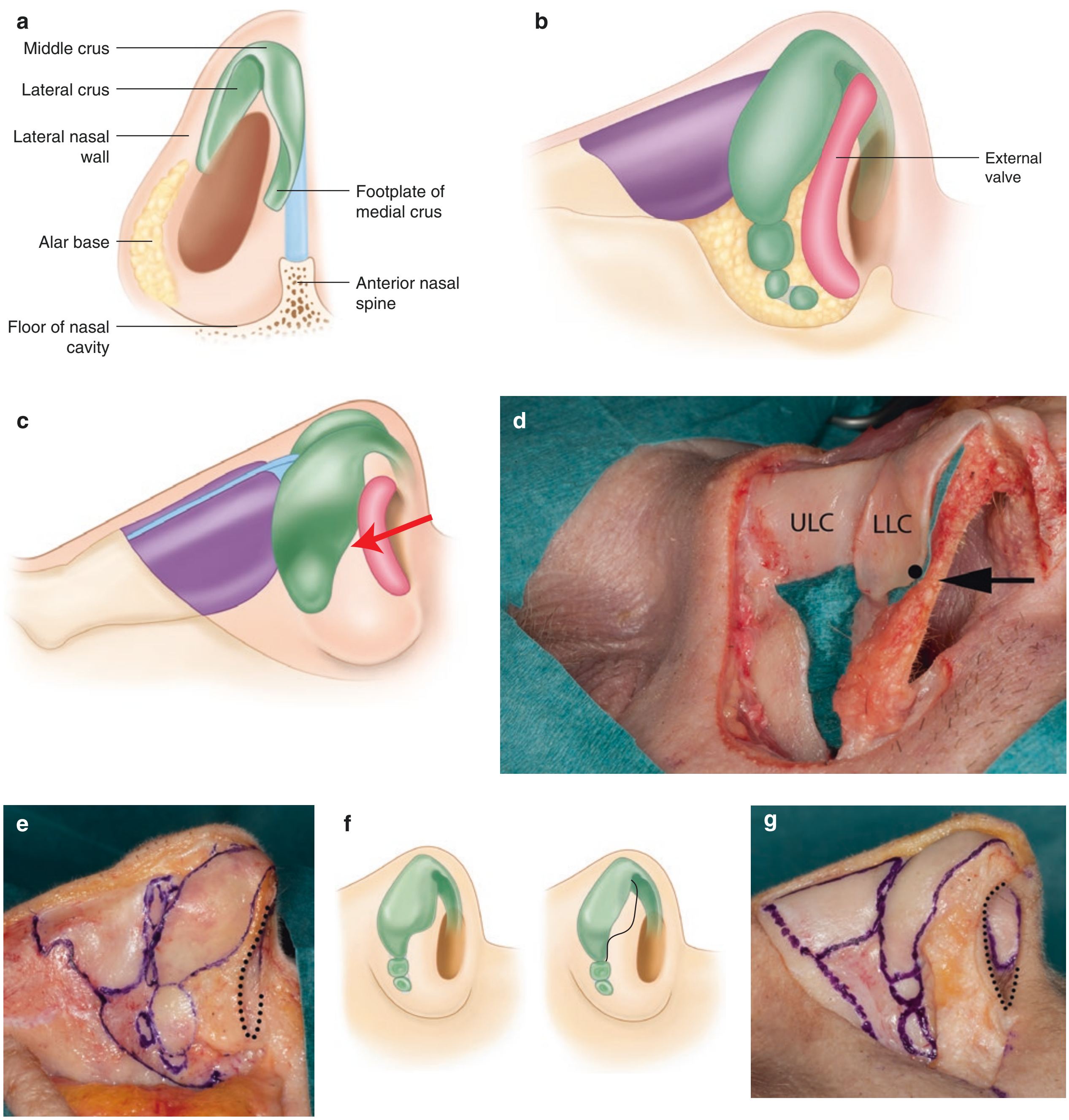


Fig. 4.34 (**a–g**) External valve

The external valve was defined by Sheen (1978), expanded by Constantian (1994), and codified by Rhee et al. (2010). The external valve is composed of those structures that form and project into the nostril aperture (Fig. 4.34). Based on our clinical experience and recent cadaver dissections, we classify ***external valve collapse*** into either ***anatomical obstruction*** or ***anatomical instability***. The three most common causes of anatomical obstruction in primary cases are caudal septal deviation, alar rim collapse, and nostril narrowing due to columellar widening (Fig. 4.35).

Fig. 4.35 The three most common causes of external valve collapse due to anatomical obstruction, before and after correction: (**a, b**) caudal septal deviation, (**c, d**) alar rim collapse, and (**e, f**) nostril narrowing due to columellar base widening

Our dissections have revealed that distinct inward collapses occur at the junction between the lateral crus at its turning point and the alar base (Fig. 4.34c, d). There is no cartilaginous support below the turning point, so collapse of the external valve begins at the "hinge" point, then occurs laterally at the nostril floor, and then extends to a more limited degree cephalically, as the domal notch provides cartilaginous support.

EXTERNAL VALVE GRAFT (CASE STUDY)

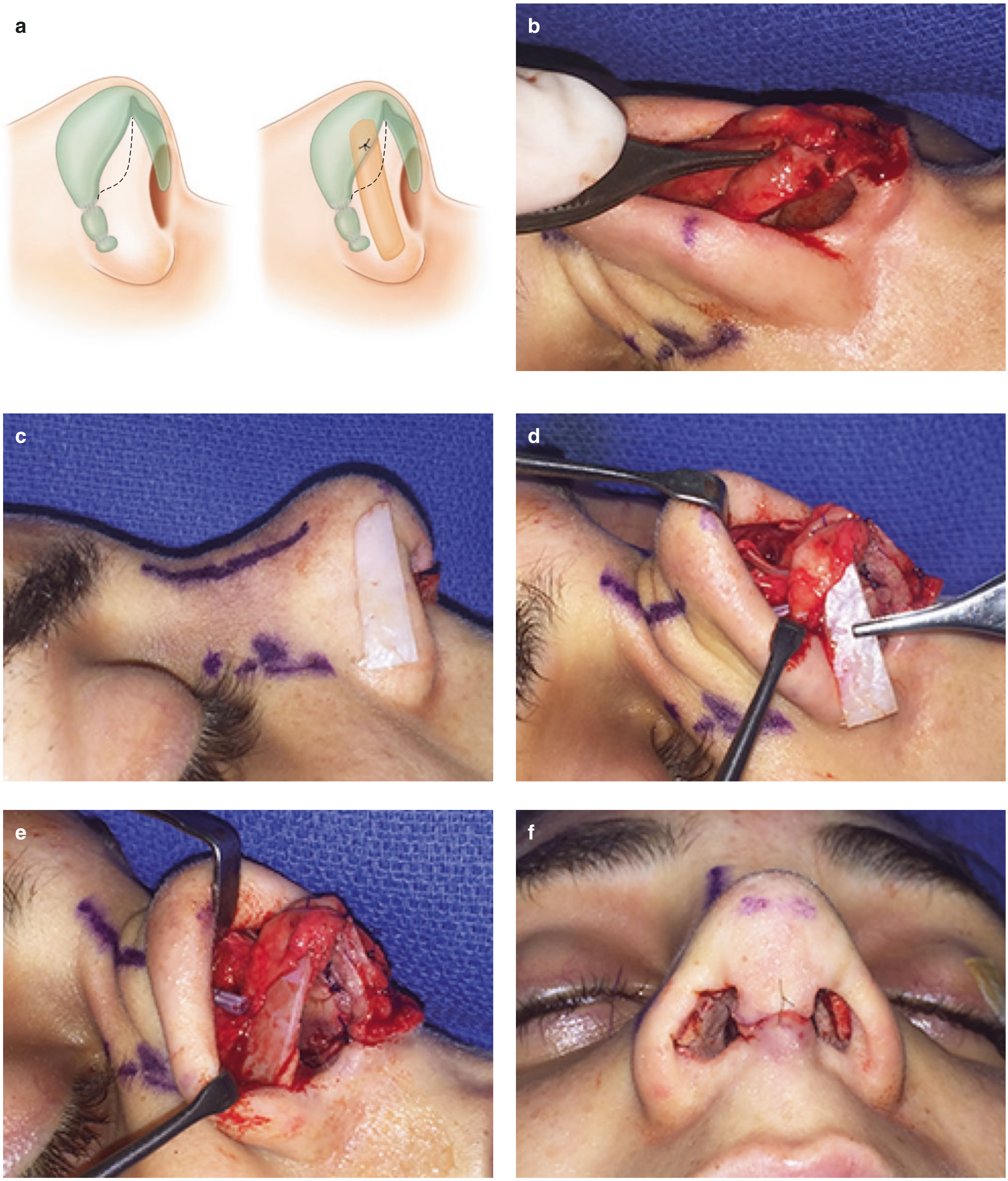


Fig. 4.36 (**a–f**) External valve graft for anatomical instability

A young woman had isolated external valve collapse due to anatomical instability. Intraoperatively, she had marked alar malposition with no support for 10 mm back from the alar rim. The solution was major external valve grafts (25 × 8 mm) which were placed under the domal area and then brought down to the alar crease. The entire hinge area thus was supported and stabilized (Fig. 4.36).

EXTERNAL VALVE GRAFT (CASE STUDY)

Fig. 4.37 Patient in the case study (**a, c, e, f**) before and (**b, d, g**) after placement of external valve grafts to correct isolated external valve collapse due to anatomical instability. Result is shown at 2 weeks. Patient was from out of town and lost to follow-up

The patient was totally obstructed at rest (Fig. 4.37e), but with only a marginal increase in severity on deep inspiration (Fig. 4.37f). The external nasal valve grafts produced marked improvement in nostril aperture, which was stabilized on deep inspiration (Fig. 4.37g). Dramatic changes were seen in columellar narrowing, outward support of the lateral alar wall, and the appearance of the nostril sill.

VESTIBULAR VALVE

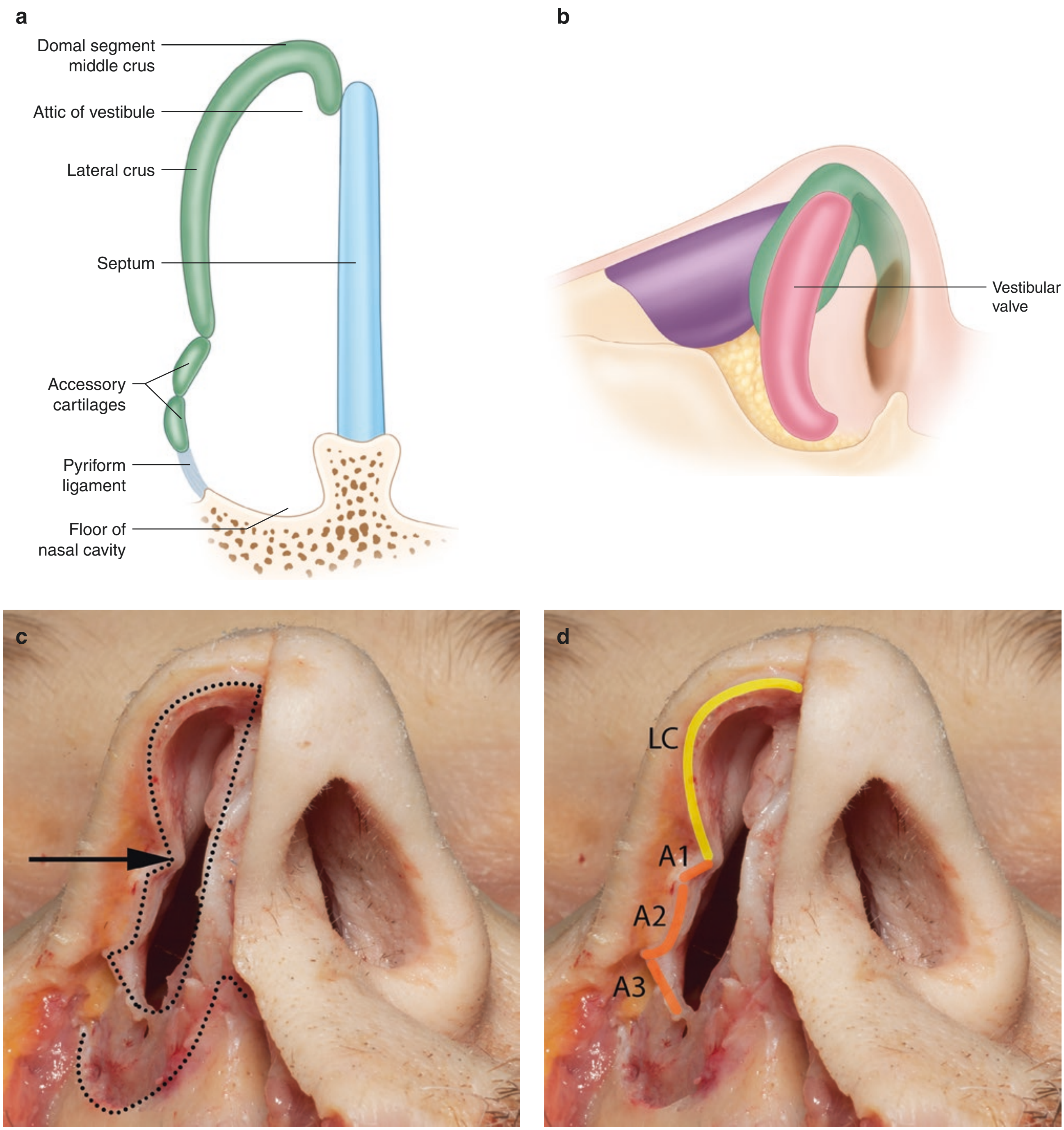


Fig. 4.38 (**a–d**) Vestibular valve anatomy. *Arrow* indicates junction between lateral crus and A-1 accessory cartilage

Anatomically, the vestibule sits between two narrow apertures—the nostril and the internal valve. Medially, the septum can be displaced into the vestibule; laterally, the lateral crus can be weakened or the lateral crus and accessory cartilage can block the airway (Fig. 4.38). In secondary cases, vestibular webbing is frequently encountered; its treatment ranges from excision to flap transposition to composite grafts (Fig. 4.39). The importance of the nasal vestibule and its role in respiration is well recognized. The classic paper of Cottle (1955) states clearly that the vestibule is an effective series of resistor baffles that slows down the air currents and directs them upward for warming and moistening. Recently, Çakır (2016) and Davis (2015) have proven the concept of *lateral crural tensioning* as a means of flattening the junction of the lateral crus and accessory cartilage junction, opening the vestibular valve.

VESTIBULAR VALVE

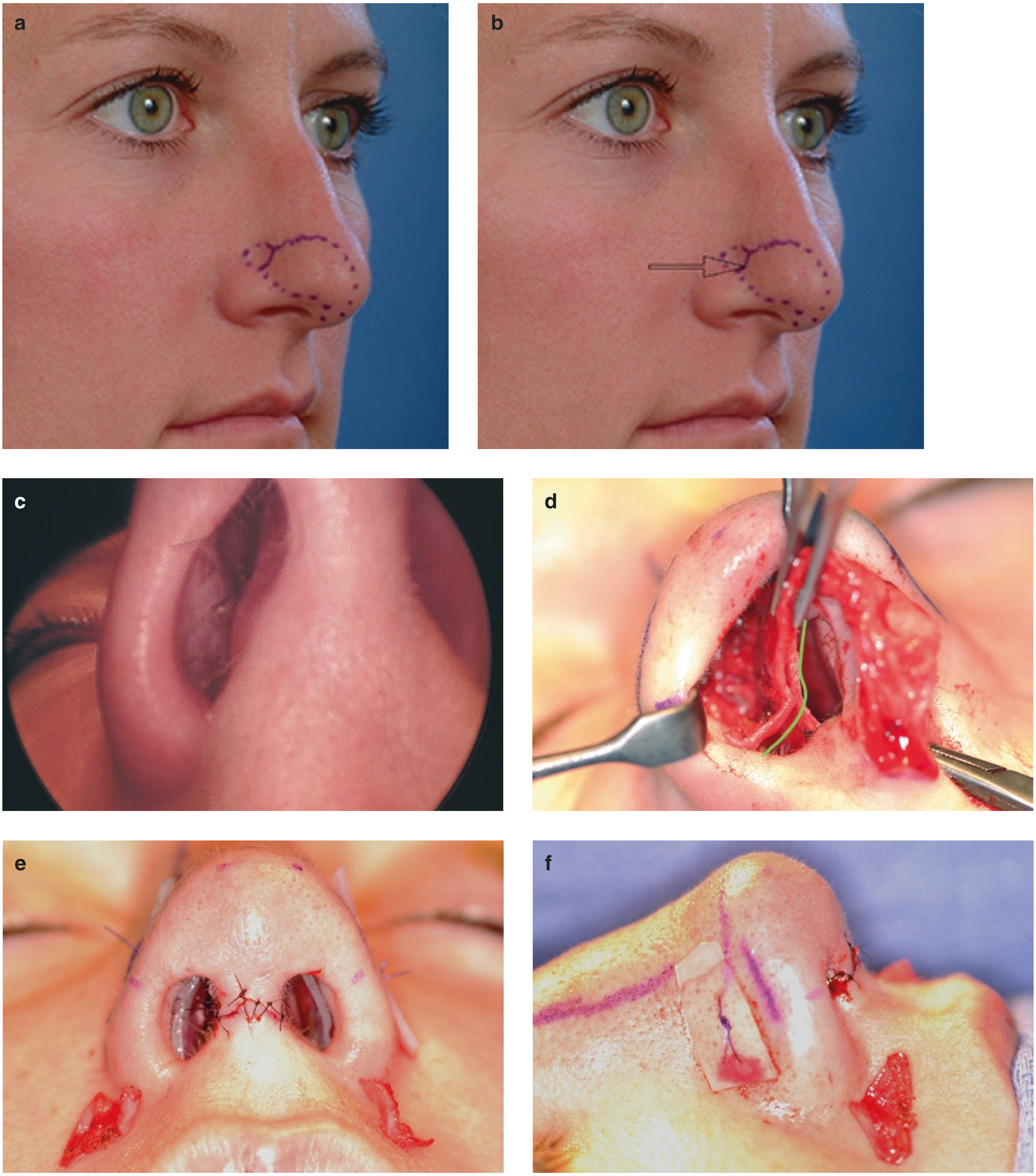


Fig. 4.39 Nasal airway obstruction due to collapse of the vestibular valve (**a**) at rest and (**b**) on deep inspiration. An (**c**) endoscopic view shows the vestibular obstruction. (**d–f**) Intraoperative views show the excision of the lateral crus–accessory cartilage junction, alar transposition, and addition of lateral crural strut grafts

INTERNAL VALVE

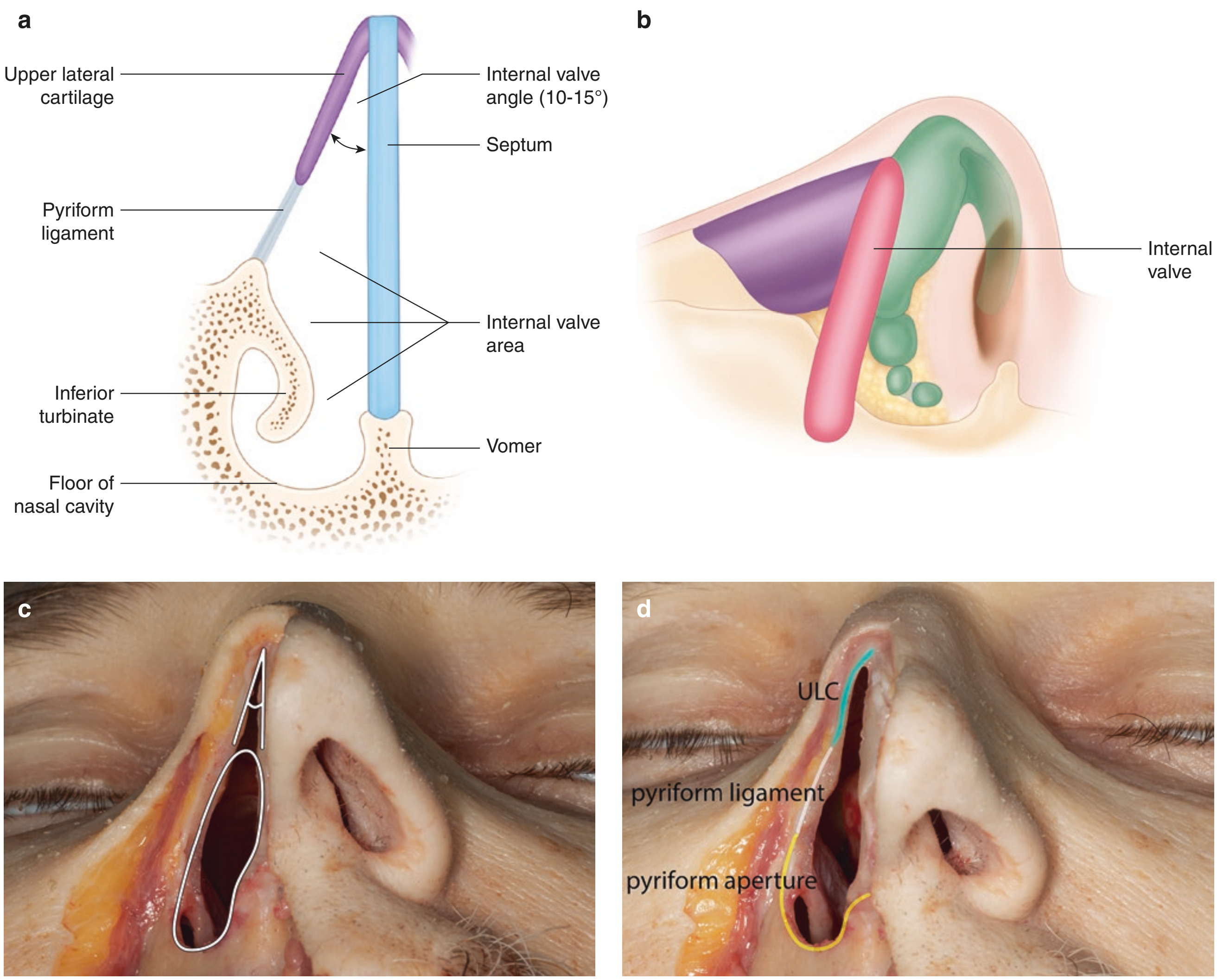


Fig. 4.40 (**a–d**) Internal valve anatomy

Perhaps the best definition of a *valve* is a *movable structure that regulates the flow of a gas or a liquid*. Mink (1903) was the first to localize the internal valve to the slit-like passage between the caudal end of the ULC and the septum. Subsequently, numerous rhinologic studies were done, which confirmed that the *internal valve* is best conceived of as the 10- to 15-degree *internal valve angle* and the larger *internal valve area* (Fig. 4.40). In primary patients, the most common causes of internal valve problems are septal deviation, turbinate hypertrophy, inward displacement of the ULC, and lateral wall collapse (Fig. 4.41). As septal and turbinate surgery are discussed elsewhere, the emphasis in this section will be on the other two problems. Clinically, one can diagnose internal valve obstruction by retracting the cheek outward, which should open up the internal valve (positive Cottle test). Intranasal inspection before and after decongestant sprays is critical to determine the specific site of the obstruction. Clinically, one should carefully examine the internal valve to determine the specific areas of obstruction, as they can often be multiple. Certainly, narrowing of the internal valve angle (Fig. 4.33b) is most frequently caused by either collapse of the ULC or bowing of the dorsal septum, assuming that one has used decongestants to eliminate mucosal swelling prior to anterior endoscopy. In primary cases, partial collapse of the ULC is the most common cause and can be corrected with spreader grafts. In posttraumatic and asymmetrical noses, deviation of the dorsal septum is a dominant factor, but narrowing of the internal valve area can be multifactorial and frequently differs on the two sides.

INTERNAL VALVE

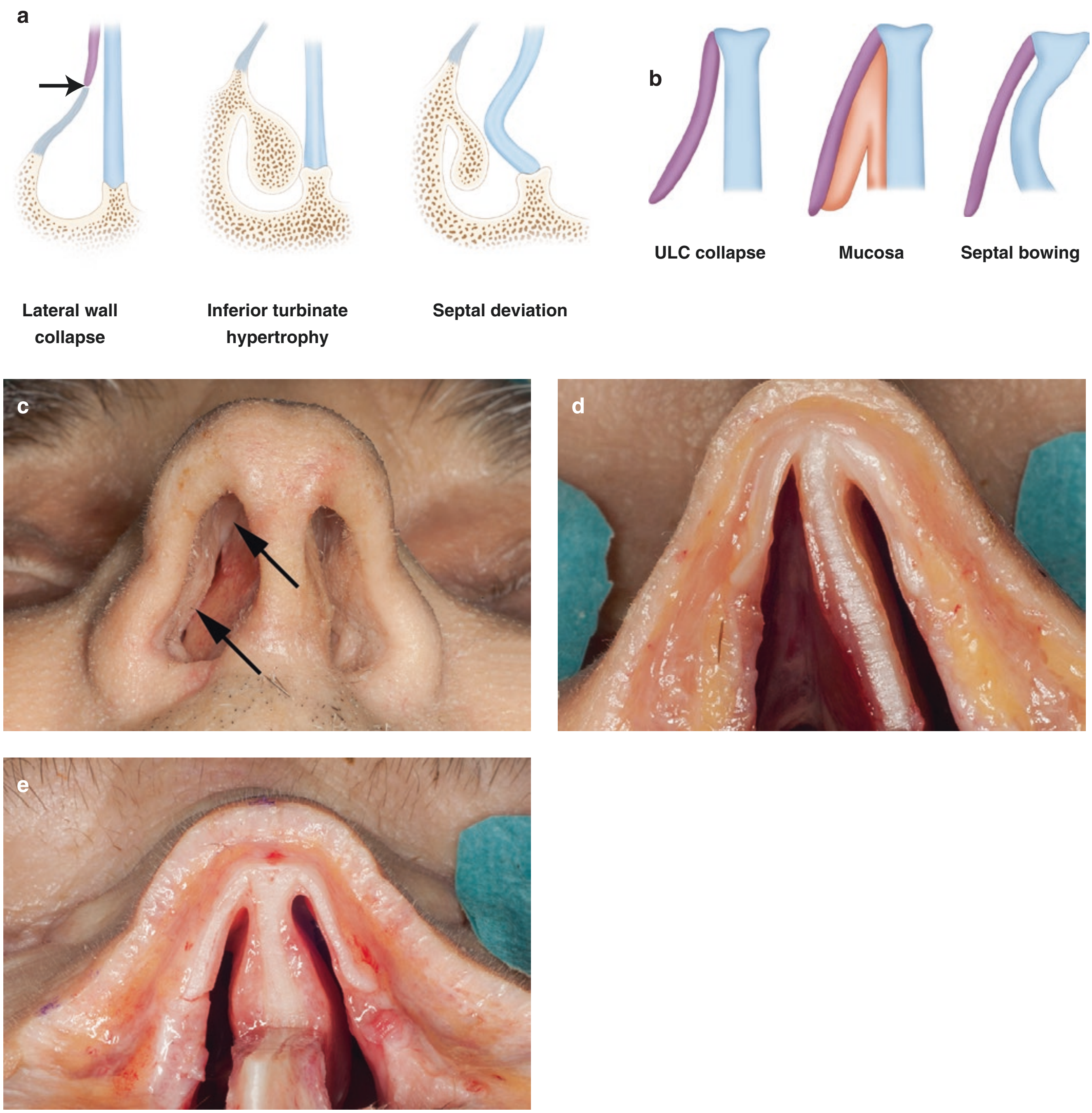


Fig. 4.41 (**a, b**) Common obstructions of the internal valve area and angle. (**c, d**) Compromise of the internal vault by septal deviation. (**e**) Hypertrophic mucosa obstructing the internal vault

Certainly, major deviations of the inferior septum can impact the lateral wall while there is significant compensatory hypertrophy of the inferior turbinate and concha bullosa of the middle turbinate on the opposite side. Treatment of inferior turbinate hypertrophy in primary rhinoplasty cases varies from 0 (Constantian 1994) to over 90% (Guyuron 2012). Certainly, we do not hesitate to employ outfracture of the inferior turbinates frequently without or with coblation. Compensatory hypertrophy is reduced whenever it is present. Lateral wall collapse is a relatively new diagnosis that is discussed below.

INTERNAL VALVE OBSTRUCTION (CASE STUDY)

Analysis: A 43-year-old woman presented for correction of nasal obstruction following a septoplasty 10 years previously. The patient had a persistent C-shape septal deviation with the body to the left and the caudal septum to the right. Of even greater severity was the marked facial and nasal asymmetry. Both the nose and the face were deviated to the right, and there was severe collapse of the left alar. CT scan showed impressive collapse of the left alar and blockage of the left internal valve (Fig. 4.42).

Operative Technique:

1. Harvest of portions of the 8th and 9th ribs. Harvest of deep temporal fascia.
2. Bidirectional exposure of the septum through an open approach and a transfixion incision.
3. Subtotal septoplasty. Resection of cartilaginous septum with evidence of prior septoplasty (Fig. 4.42b).
4. Spreader grafts of septal cartilage on either side of the septocolumellar graft.
5. Lateral crural strut graft on the left, plus a turnover graft.
6. Alar rim structure graft on the left. Fascia graft to radix and dorsum.

Commentary: Essentially, the patient has done well and her respiration has improved. Aesthetically, the nose looks much better (Fig. 4.43). This case is a typical example of the result being all "-er words" (straighter, better, cuter) and no "-t" words (perfect, straight).

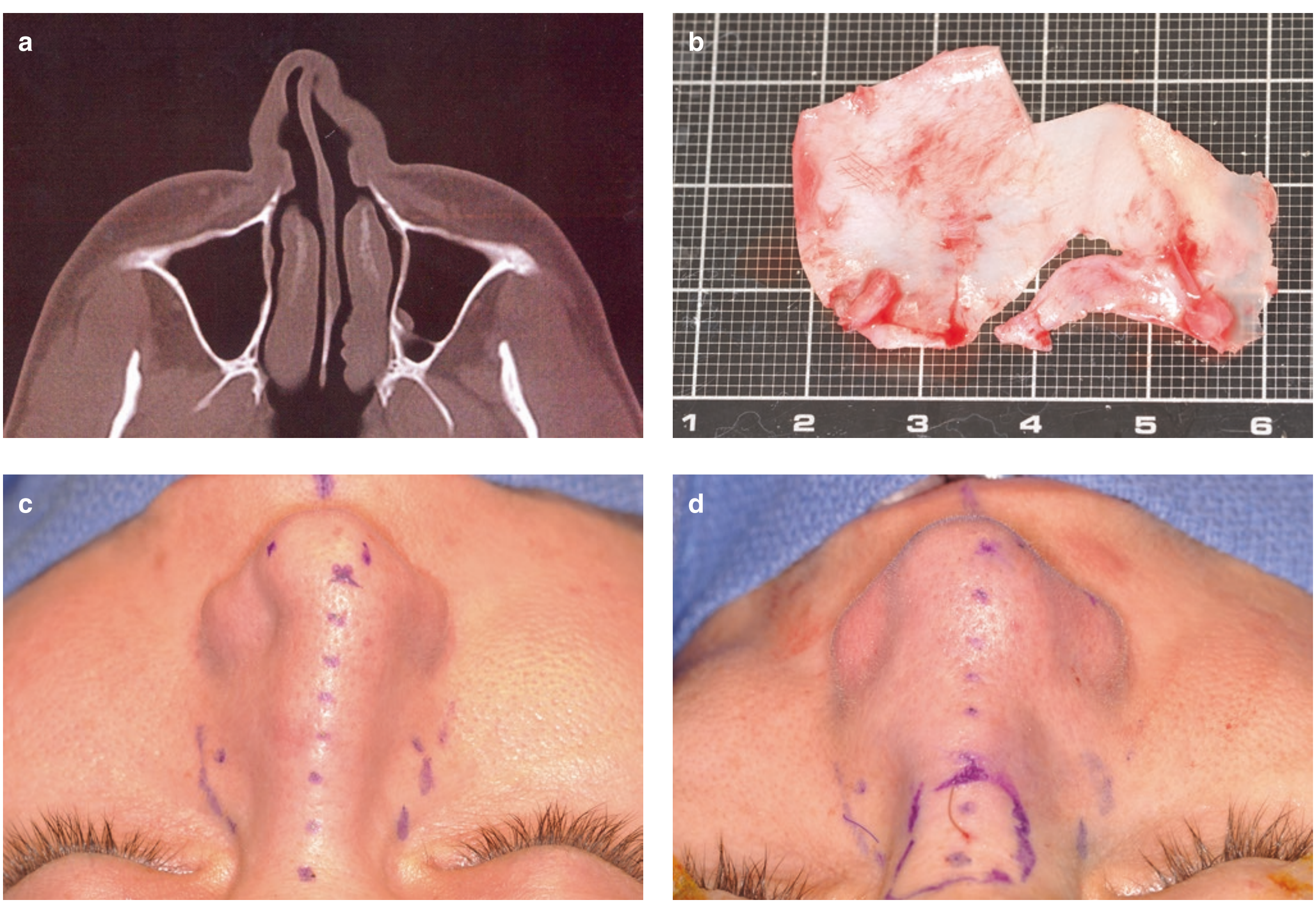


Fig. 4.42 (**a–d**) CT scan and intraoperative pictures showing correction of internal valve obstruction and nasal asymmetry

INTERNAL VALVE OBSTRUCTION (CASE STUDY)

Fig. 4.43 (**a–h**) Patient in case study, before (*left*) and after (*right*) surgery to correct internal valve obstruction and asymmetry

BONY VALVE

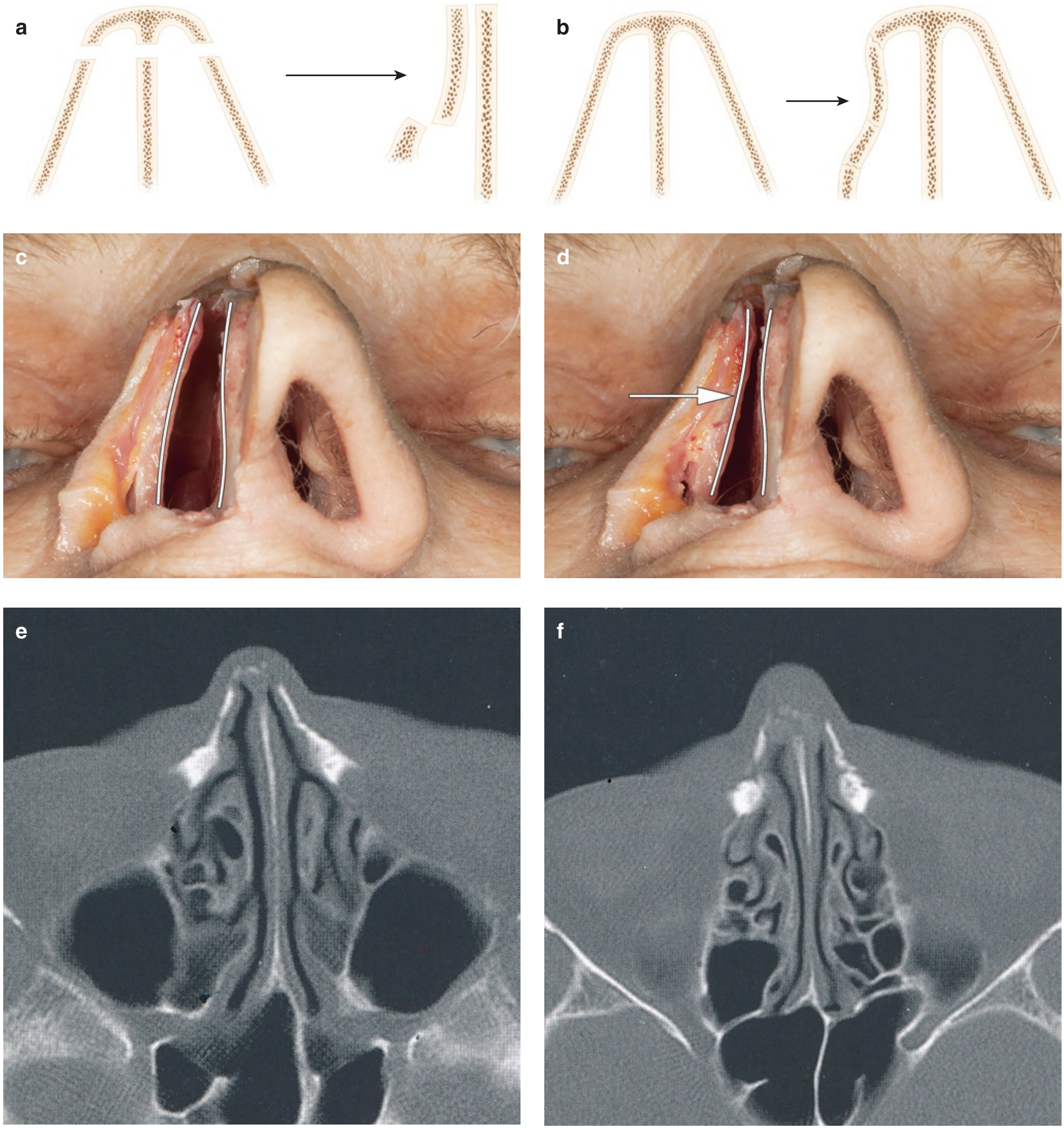


Fig. 4.44 (**a–f**) Bony valve obstruction after rhinoplasty or post-traumatic etiology

The concept of a bony valve evolved during examination of secondary rhinoplasty patients and was then confirmed in primary posttraumatic cases. In secondary rhinoplasty patients, excessive verticalization of the lateral bony wall can occur, especially after medial osteotomies (Fig. 4.44). In primary cases, the usual cause of obstruction is trauma in which the lateral wall is compressed against the septum. During the intranasal examination, one can see that the internal valve is blocked by a verticalization of the ULC, but when the ULC is elevated, it is obvious that the airway is still blocked by the lateral bony wall. The etiology is primarily *medial movement and increased verticality* of the bony lateral wall, both of which compromise and narrow the nasal passageway.

BONY VALVE

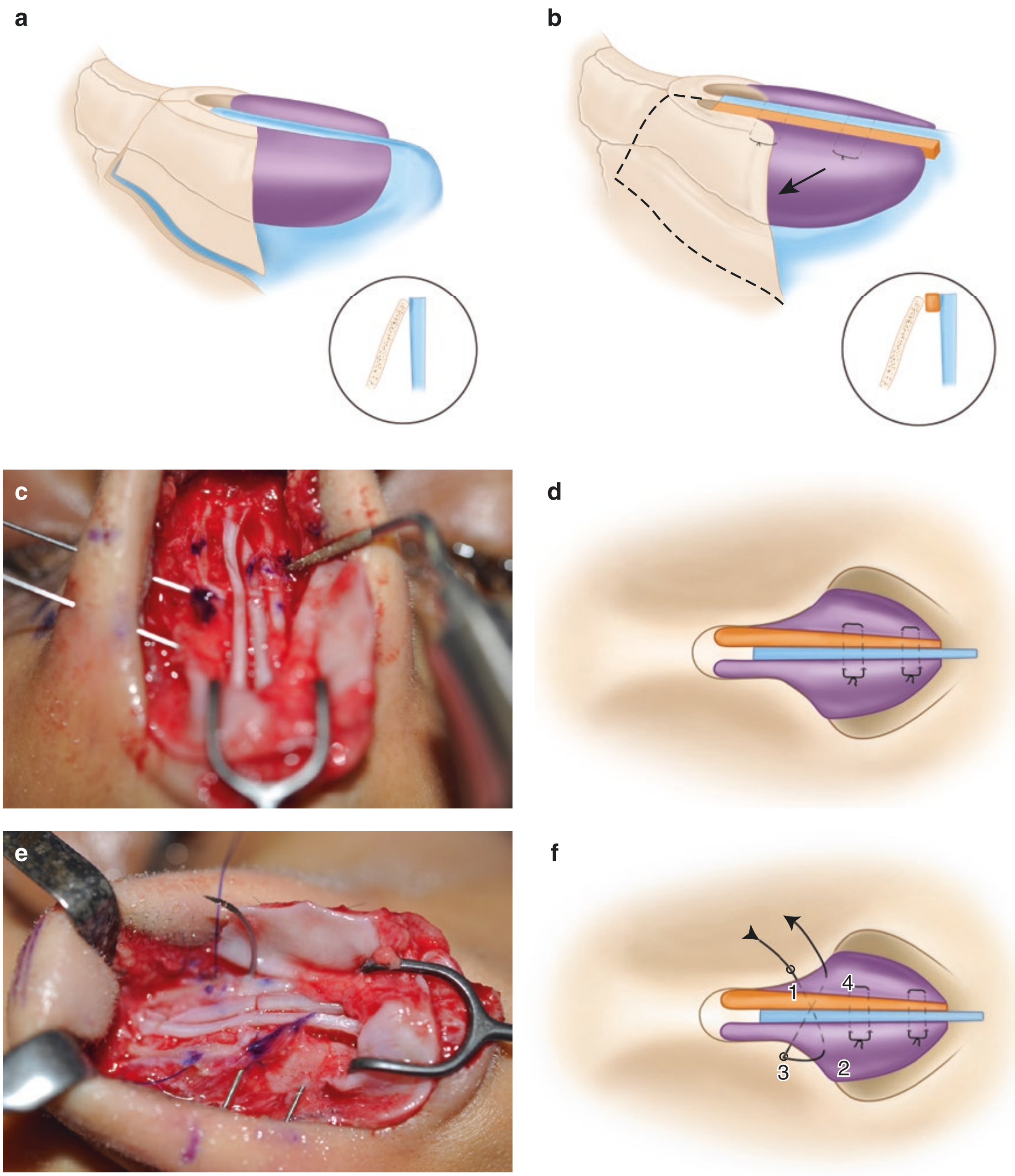


Fig. 4.45 (**a–f**) Treatment of bony valve collapse

To correct the obstruction, one must achieve total mobilization of the bony wall (Fig. 4.45). One often must perform medial oblique, transverse, and low-to-low osteotomies. Once the osteotomies are completed, a Boies elevator is then placed in the nose and the lateral wall is moved outward and angulated. With concurrent external finger palpation, the surgeon can feel the bone being brought upward and outward. Stabilization in the desired position requires major spreader grafts extending high into the bony vault to force the wall outward. Doyle splints with the dorsal flange cut off permit the tube portion to be put high in the airway and provide outward distraction for 2–3 weeks. In severe cases of instability, it may be necessary to place a pair of parallel drill holes in each nasal bone. The spreader grafts are then brought high into the bony vault and fixed with a #25 needle through the most cephalic holes. The distal portions of the spreader grafts are sutured to the ULCs or a strut. Then a 4-0 PDS suture is placed through the caudal holes in the nasal bones and tied in an overlapping fashion. The upper needle is removed, and a second suture is placed through the cephalic holes. These two sutures will stabilize the bony pyramid.

DYNAMIC LATERAL WALL: ANATOMY AND COLLAPSE

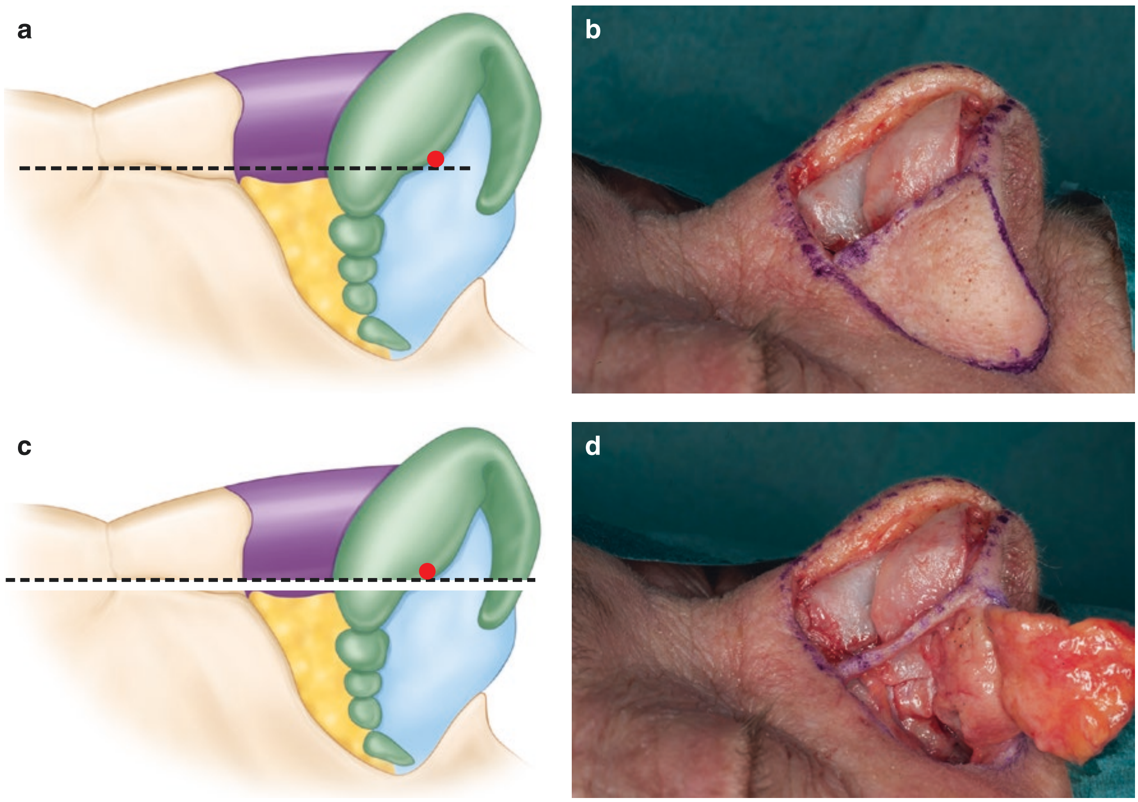


Fig. 4.46 (**a–d**) The lateral nasal wall can be divided into a semirigid, cartilaginous upper portion and a dynamic lower portion, as is readily apparent on the cadaver dissection

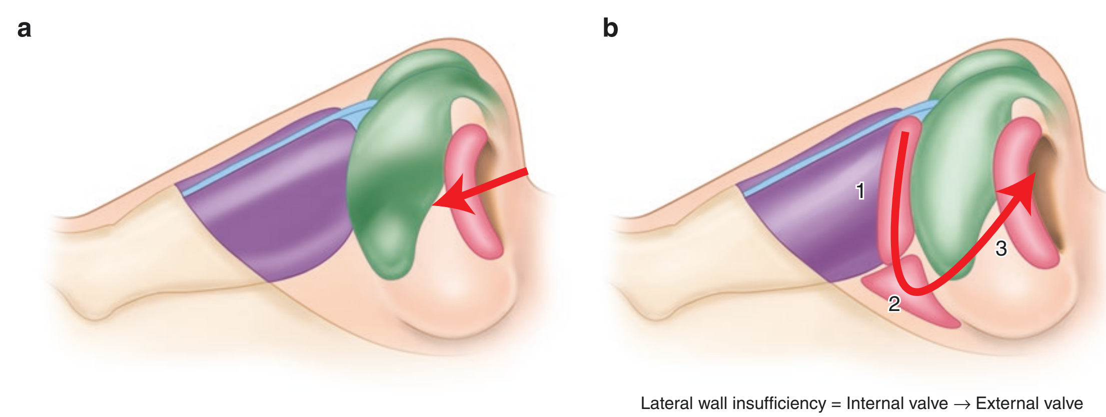


Fig. 4.47 (**a**) External valve collapse and (**b**) combined internal and external valvular collapse

In 2013, we presented our concept of a dynamic lateral wall with an upper semirigid, cartilaginous portion and a lower nonstructural, mobile portion (Fig. 4.46) (Palhazi and Daniel 2013). From these dissections, it was obvious that the upper third is cartilaginous, with the dynamic area being in the scroll junction between the alar and the ULCs—that is, the internal valve angle. In contrast, the lower two thirds consisted of three distinct components (listed from caudal to cephalic): (1) the nostril rim/alar base, (2) the accessory cartilage chain, and (3) the mucosal space. These three areas are designed to be flexible and to respond dynamically to the nasal musculature. Yet traditionally, surgeons want to separate the internal and external nasal valves into distinct entities, and often focus on their static obstruction, which is amenable to surgical correction (Rhee and Kimbell 2012; Most 2015). Although isolated external valve collapse is a distinct, separate entity (Fig. 4.47a), it often is combined with internal valve collapse, resulting in dynamic lateral wall collapse (Fig. 4.47b).

DYNAMIC LATERAL WALL: ANATOMY AND COLLAPSE

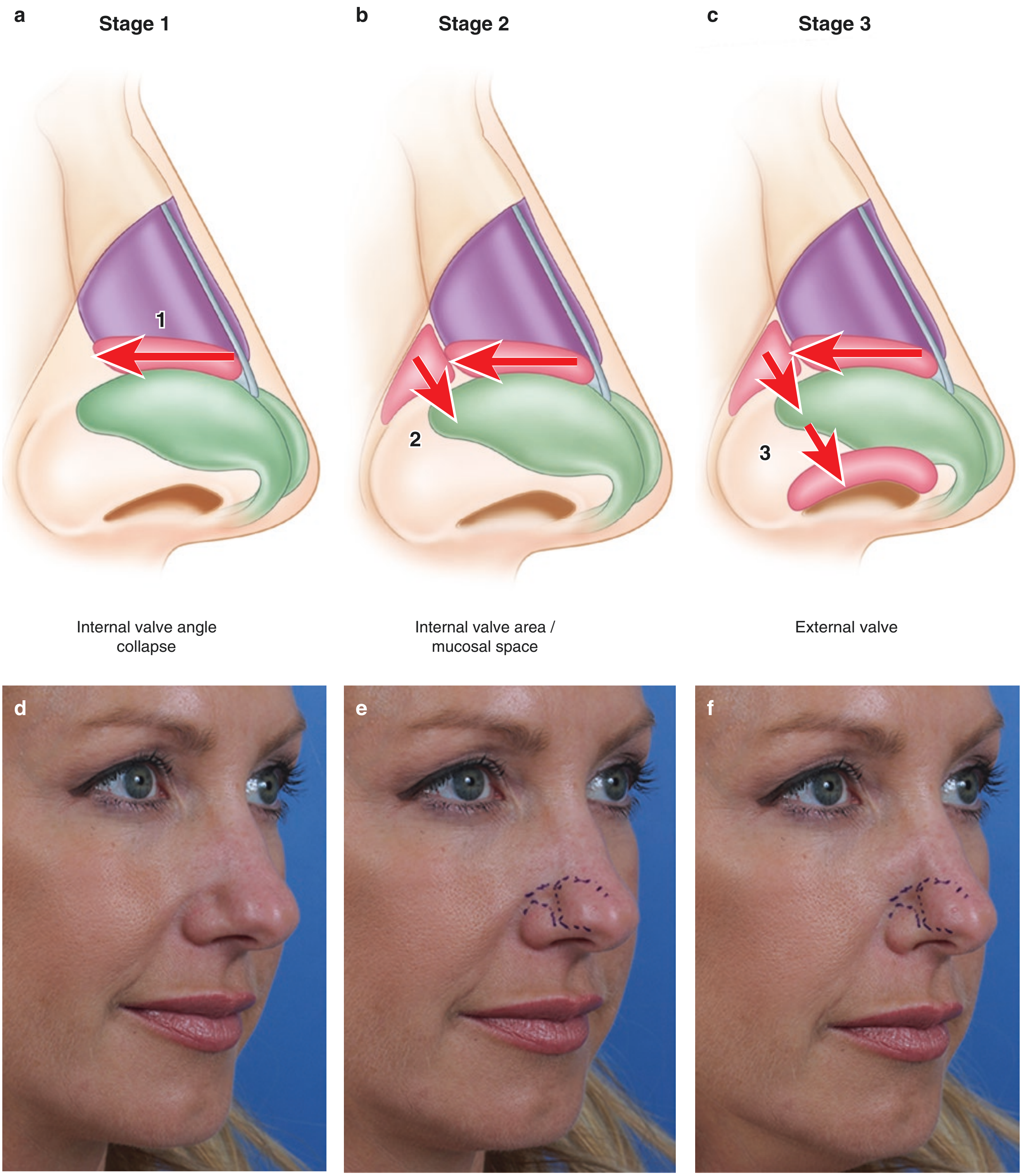


Fig. 4.48 (**a–f**) Progressive lateral wall collapse

If one observes a large number of patients with a lateral wall collapse—especially in slow-motion videos—it becomes obvious that there is a *dynamic progression* from closure of the internal valve angle to the lateral wall to the external valve (Fig. 4.48). This collapse is a direct consequence of the negative pressure gradient generated by the Bernoulli effect.

LATERAL WALL COLLAPSE (CASE STUDY)

Analysis: A 26-year-old woman presented with a history of nasal obstruction and complained that she did not like the appearance of her nose, especially the profile. Interestingly, her external valve collapsed on deep inspiration. On gradual inspiration, one could see the mucosal space compress and the collapse come downward to the alar rim. On basilar view, the right nares collapsed entirely, whereas the left nares narrowed significantly. Internal examination showed septal deviation to the right in both the caudal portion and the body of the septum, as well as partial interior turbinate hypertrophy. Lowering of the dorsal profile would eliminate her "tension nose."

Operative Technique: Essentially, eight steps would be done to improve this patient's respiration (Fig. 4.49):

1. Open approach, septal exposure. Lowering of the cartilaginous "tension" dorsum by 5 mm.
2. Septal resection of the deviated body and relocation of the septum from right to left.
3. No osteotomies.
4. Bilateral partial inferior turbinectomy with radiofrequency coblation followed by outfracture.
5. Spreader grafts and spreader flaps.
6. "Mucosal space graft" of thinned bony ethmoid plate.
7. Lateral crural strut grafts placed out to the pyriform aperture.
8. Alar rim structure grafts placed along a true marginal rim incision.

Commentary: Postoperatively at one year, the patient breathes well and has no evidence of nasal obstruction. Her external valve does not collapse on deep inspiration through her smaller, more attractive nose (Fig. 4.50).

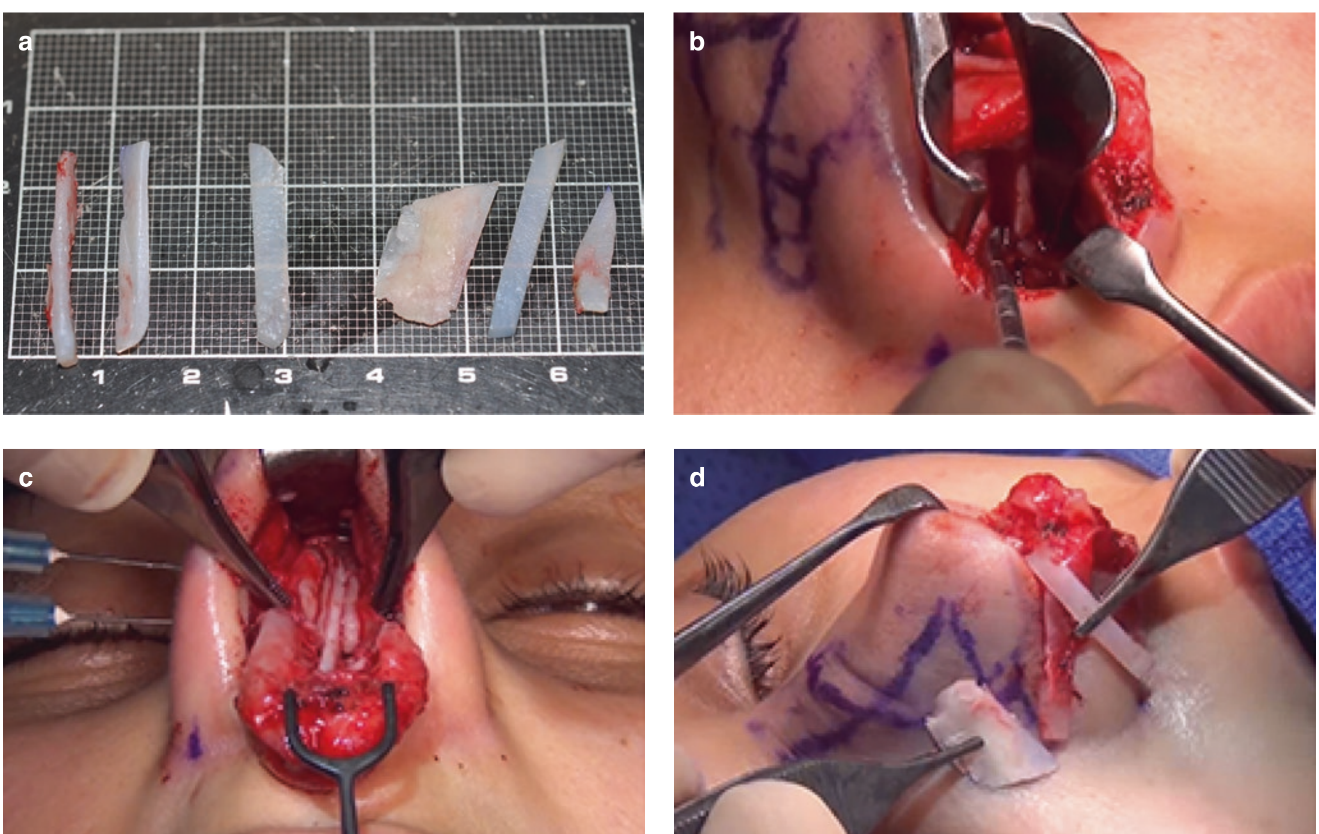


Fig. 4.49 (**a–d**) External valve reinforcement in a woman with lateral wall collapse

LATERAL WALL COLLAPSE (CASE STUDY)

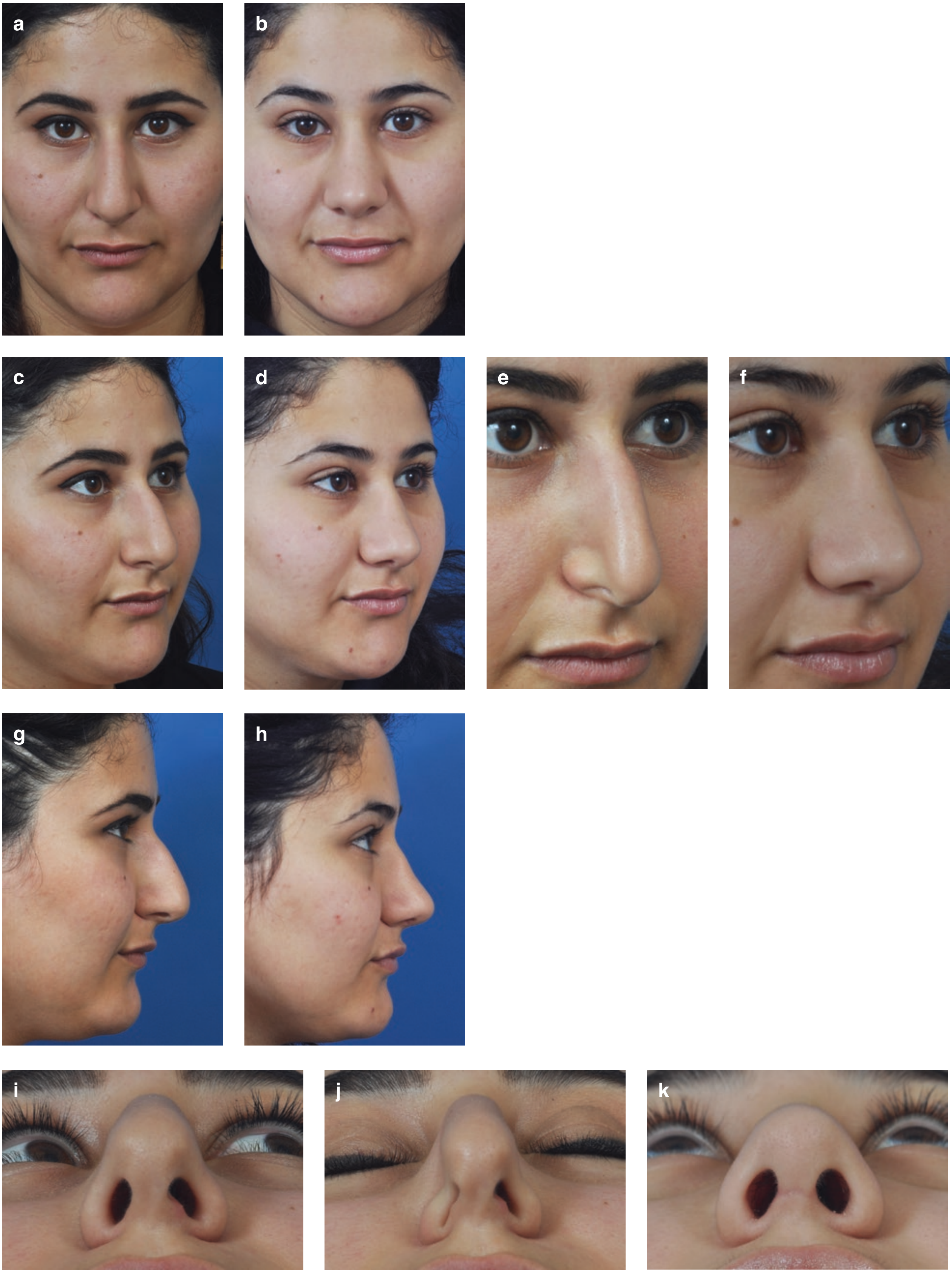


Fig. 4.50 (**a–k**) Patient in case study, before (*left*) and 1 year after (*right*) surgery to correct lateral wall collapse (as seen in the *bottom row*)

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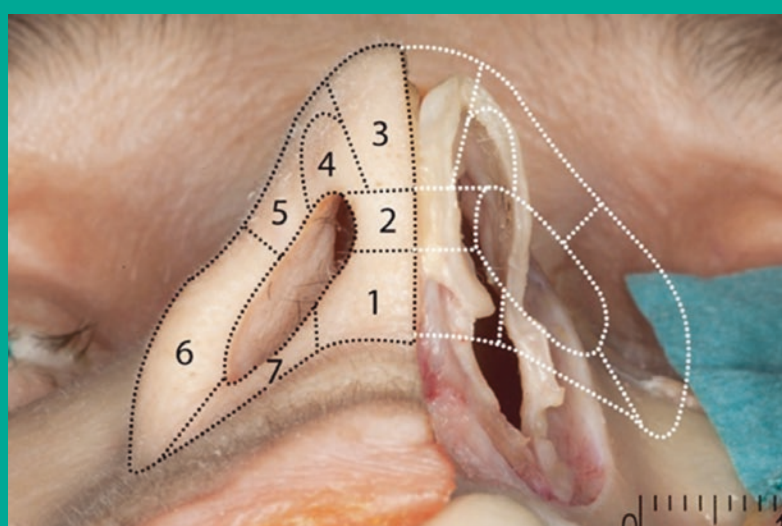
5

Nasal Base



The nasal base is probably the least understood and most complex area of the nose. Surgical errors of omission lead to less than optimal results, and errors of commission can produce irreparable deformities. Errors occur because surgeons assume that these are “ancillary techniques” rather than an *integral* part of a rhinoplasty. Alternatively, perhaps not enough time is taken to study the aesthetic and anatomical subtleties of the area. Unfortunately, analysis can be complex, and the etiology of a problem, multifactorial. Also, the impact of adjacent structures is of critical importance. One must always assess the influence on the columella of the caudal septum, which can result in deviation, retraction, or a hanging deformity. We subdivide the nasal base into seven different components, each of which requires analysis and can be modified surgically. Surgeons have long excised portions of the nasal sill or alar base without recognizing the importance of the tela subcutanea cutis. Equally, the addition of alar rim grafts to control nostril support has long been performed, but controlling the shape and support of the soft tissue facet is a recent advance. Despite the analytical complexity, most surgical solutions are straightforward once the correct diagnosis is made, but the procedure must be done meticulously to prevent permanent deformities.

OVERVIEW

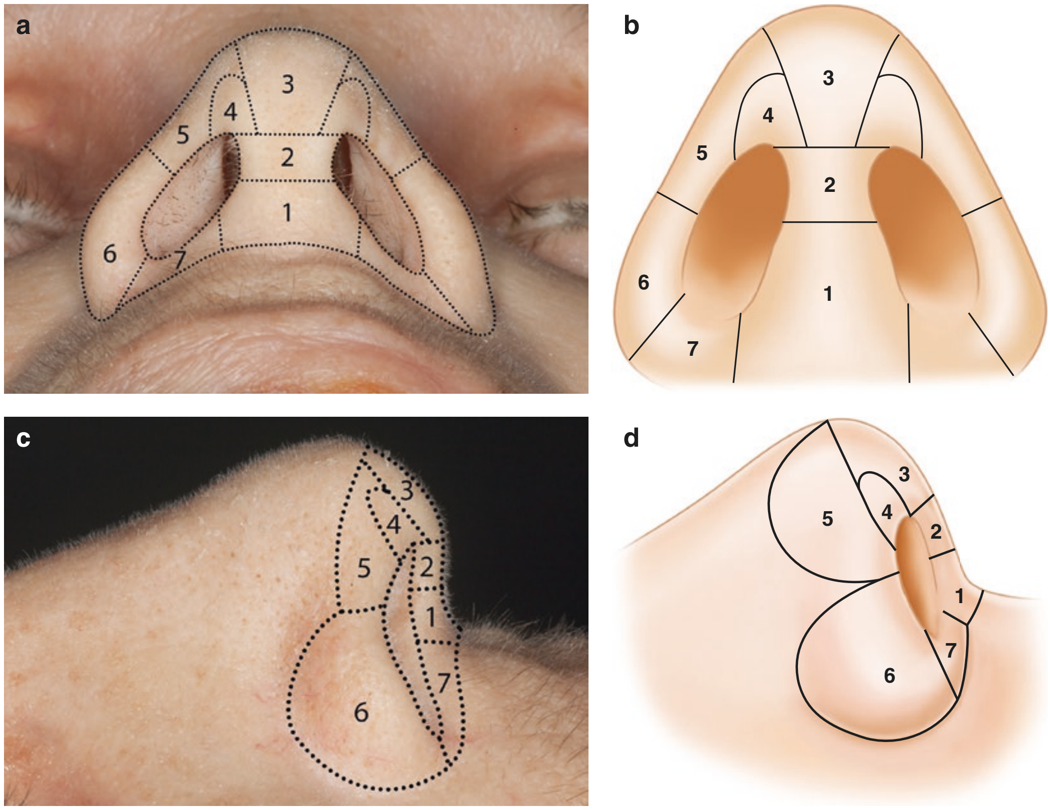


Fig. 5.1 (**a–d**) The seven areas of the nasal base

From both an anatomical and aesthetic perspective, the nasal base is subdivided into seven components, as illustrated in Fig. 5.1 (Daniel 1993):

1. columellar base
2. central columellar pillar
3. infralobular triangle
4. soft triangle
5. lateral wall
6. alar base
7. nostril sill

This component approach is best appreciated on basilar view. The transverse width of the columellar base (1) is related to the separation of the footplates and the quantity of intervening soft tissue. The caudal septum and anterior nasal spine (ANS) are critical in determining the columella-labial angle (CLA), as seen on the lateral view. The central columellar pillar (2) is created by medial crura apposition and their termination at the columellar lobular junction. The infralobular triangle (3) and soft triangle (4) are the capstone of the basilar pyramid. The length of the columellar segment of the middle crura determines the height of the triangle and the width of its divergence. The soft triangle is a reflection of the width of the domal notch and consists of a web of surface and vestibular skin devoid of cartilage. The lateral wall (5) reflects the support and proximity of the lateral crura to the alar rim. It is the cephalic sweep of the lateral cartilage away from the rim that creates the alar rim breakpoint and marks the junction between lobule and alar base. The alar base (6) is composed of subcutaneous tissue and muscles. It serves as an external baffle for the nose as influenced by the facial musculature. It is an area of surgical importance, as it determines the amount of alar flare and interalar width. The nostril sill (7) varies widely in its vestibular and cutaneous surfaces. The alar base can end abruptly, creating a flat nostril sill, or it can have a rolled, continuous border. Equally, the footplates can extend laterally, leaving an ill-defined nostril sill.

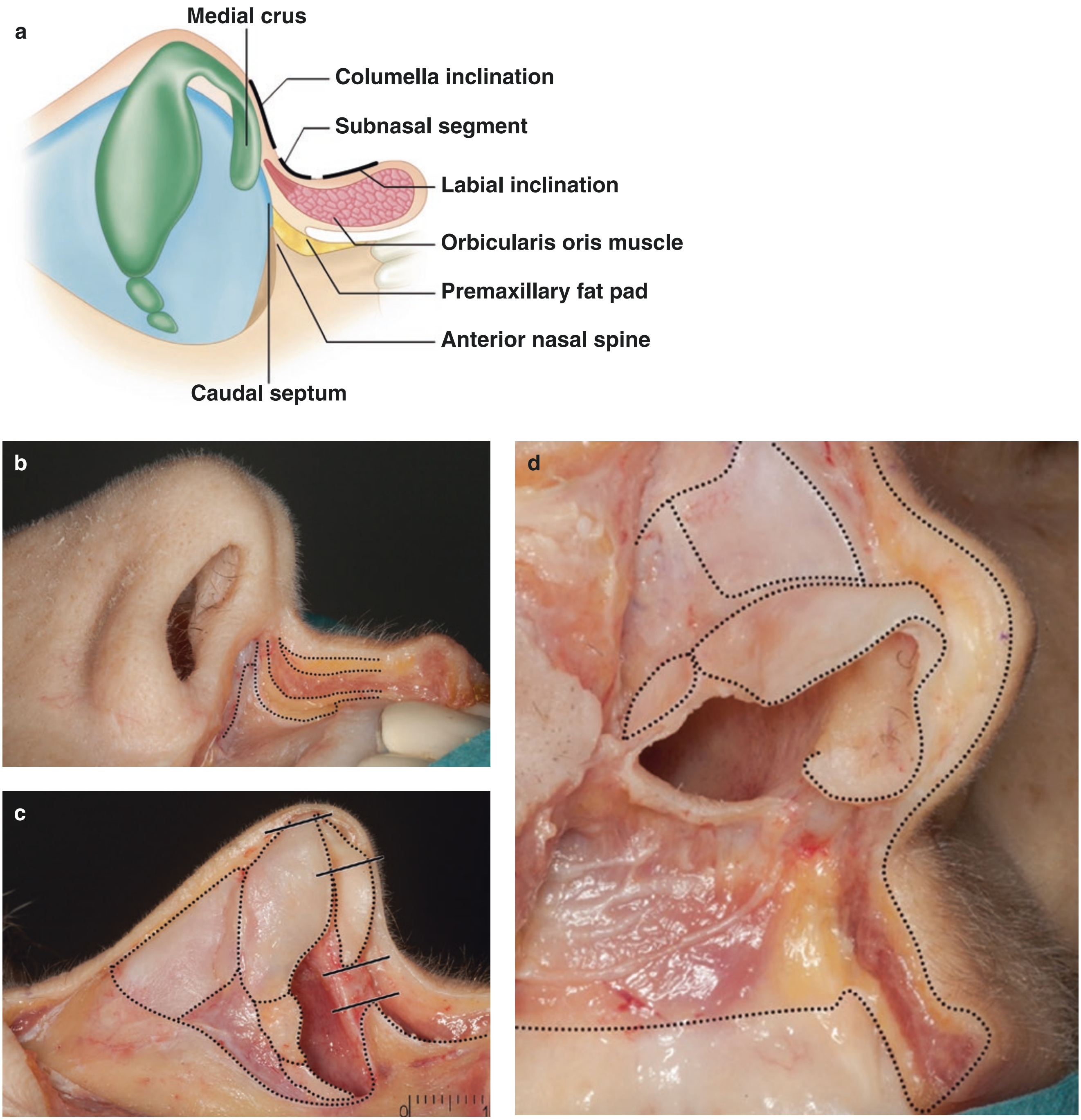


Fig. 5.2 (**a–d**) Nasal base overview

The nostril is obviously the void whose shape is determined by the surrounding structures. It is on lateral view that one begins to appreciate the important interrelationship between the nasal base and its abutting structures. The *columella-labial angle (CLA)* is a critical aesthetic landmark. As seen on cadaver dissection, the key anatomical finding is that the distance from the maxilla's A-point to the tip of the nose is often 4 cm, and it breaks down into four 1-cm segments: the ANS, caudal septum, medial crus, and middle crus (Fig. 5.2c). The ANS determines the projection from the maxilla and may have a webbed bony ridge beneath it. The caudal septum determines the columellar limb, as it is covered by soft tissue centrally but no cartilage for 1 cm before the medial crura meet in the midline. The labial limb is determined by the shape of the maxilla and its relationship with the soft tissues that comprise the upper lip.

AESTHETICS (EXTRINSIC)

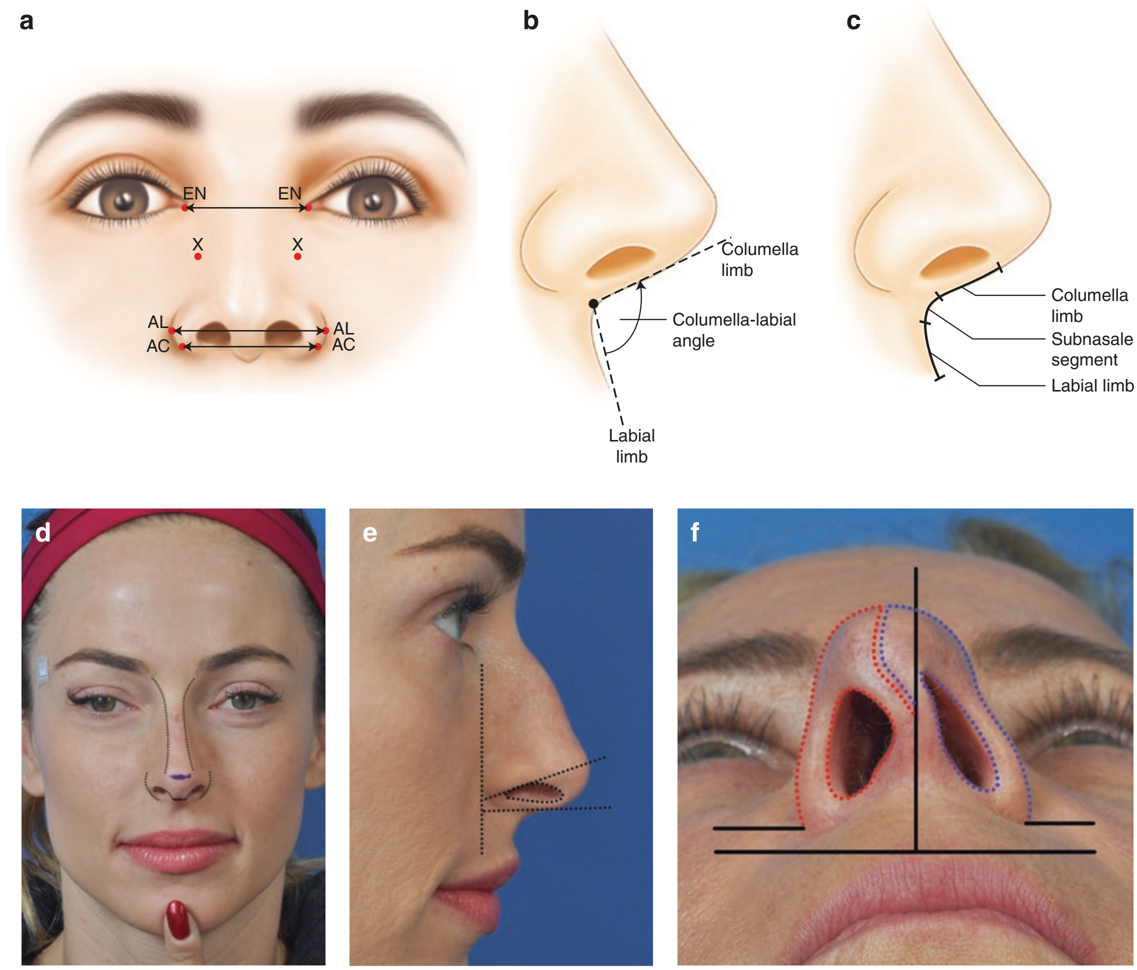


Fig 5.3 (**a**–**f**) Extrinsic aesthetics. AC–AC—interalar width; AL–AL—alar flare; EN–EN—intercanthal width; SN—subnasal

The alar flare (AL–AL), the widest point between the alar bases, usually occurs several millimeters above the alar crease (Fig. 5.3). In contrast, the interalar width (AC–AC) denotes the distance between the alar creases, which is usually less than the alar flare (Daniel 2002). The distinction is important, in that alar flare can be easily reduced by alar wedge excision, whereas reduction of the interalar width requires combined excision of the alar base and nostril sill. Aesthetically, the alar bases should be narrower than the intercanthal width (EN–EN). These values are easily measured with a ruler or caliper on anterior or basilar view.

As previously noted, the CLA is created by the intersection of the columella tangent and lip tangent at the subnasale (SN). Each component must be analyzed separately. The columella limb is a very powerful indicator of upward nasal rotation. A true **columellar angle** is measured by extending the columellar tangent line back to the vertical axis passing through the alar base. It should parallel the tip angle and be approximately 103° in females and 95° in males. The columella should have a slight convexity, avoiding a retruding concavity or a hanging prominence. The labial limb relates to the upper lip, with the ideal at −6° from the upper lip vertical while avoiding either retrusion or prominence. One must consider the obvious influences of the maxilla, occlusal relationship, teeth inclination, and upper lip composition. The subnasal segment should be a gradual curve interconnecting the columella limb and the labial limb; a sharp acute point lengthens the upper lip while a blunted convex web shortens the upper lip. Nearly all columellar problems are deviations due to the caudal septum, which require caudal septal relocation. The next most common deformity is the hanging columella, due to a prominent caudal septum. It can be resected for shortening, rotation, or both.

AESTHETICS (INTRINSIC)

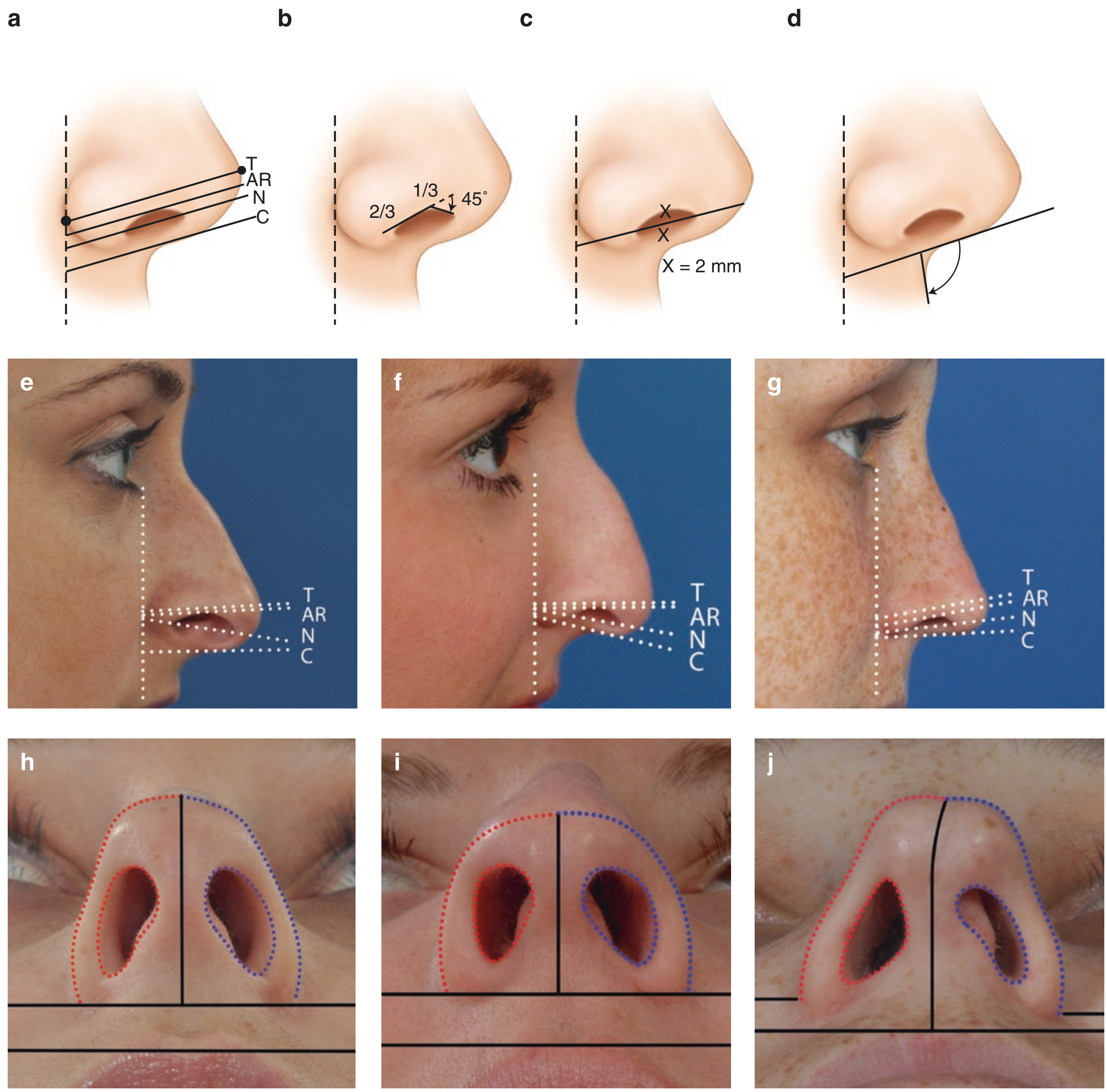


Fig. 5.4 (**a–j**) Intrinsic aesthetics. AR—tangent of alar rim; C—columella inclination; N—nostril inclination; T—tip angle

Analysis of the alar rim–nostril–columella (ARNC) complex begins with drawing four inclinations on lateral view: tip angle, tangent of the alar rim, nostril inclination, and columella inclination (Fig. 5.4). It is critical that the requisite tip angle and columella inclination be achieved before modifying the nostrils. The breakpoint of the alar rim is marked, as well as the proximal limb, which should be twice the distal limb; the angle of intersection should be approximately 45°. The nostril circumference is drawn, which incorporates the alar rim cephalically and the posterior portion of the columella caudally. A line is drawn through the terminal points of the nostril, and the resulting bisection is classified as follows (Gunter et al. 1996): (1) ideal, with 2 mm on either side; (2) excesses greater than 2 mm indicating a retracted alar rim, hanging columella, or both; and (3) Reductions of 1 mm or less, denoting a hanging alar rim or retracted columella.

On basilar view, a horizontal line is drawn across the philtrum and a vertical from that line to the columellar breakpoint (c′) and then from c′ to the tip (T). The alar crease is marked and its level is indicated. Each nostril is outlined with a different color. With these marks, any asymmetry becomes obvious.

ANATOMY OF THE NASAL BASE

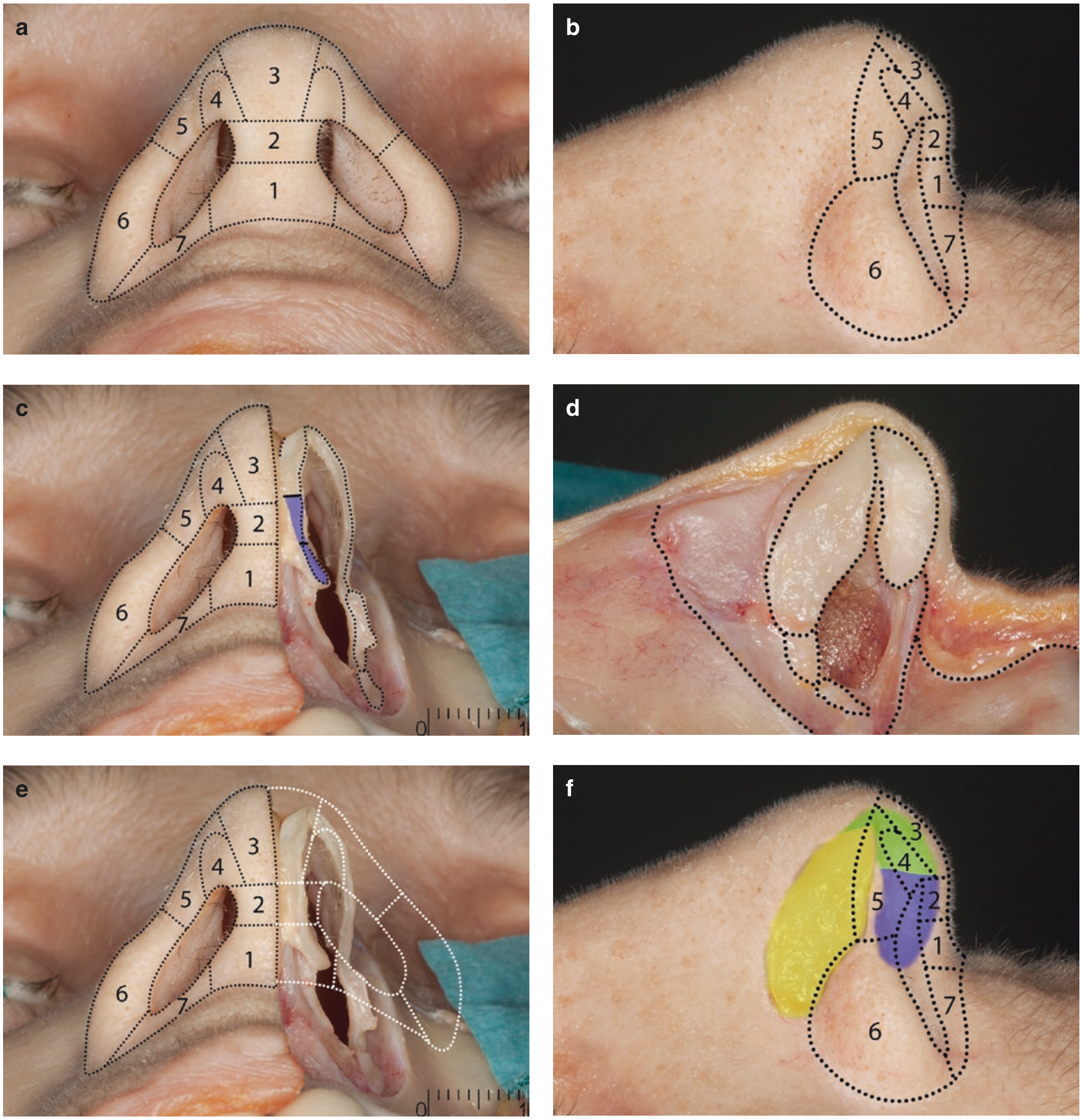


Fig. 5.5 (**a–f**) Subunits and underlying anatomy of the nasal base

Analysis is important in defining deformities and planning operations on the nasal base. Very few surgeons and rhinologists understand that the entire nostril rim is purely soft tissue with virtually no direct cartilaginous component. Rather, it is essentially a ***soft tissue ring,*** which is impacted dramatically by abutting extrinsic forces. Analysis requires careful consideration of all seven areas of the nostril base seen on basilar view and careful angular analysis on lateral view (Fig. 5.5). Ultimately, the surgeon's brain must see the defining multicomponent perimeter, while the artist's brain sees the nostril aperture. It is by operating on these seven areas that we can have a profound effect on the nose and achieve a superior result rather than an average one. Equally, there are critical functional relationships to the external nasal valve. Following a brief discussion of the blood supply, this part of the text discusses each of the seven areas in greater depth, focusing on their anatomy and surgical modification.

BLOOD SUPPLY TO THE NASAL BASE

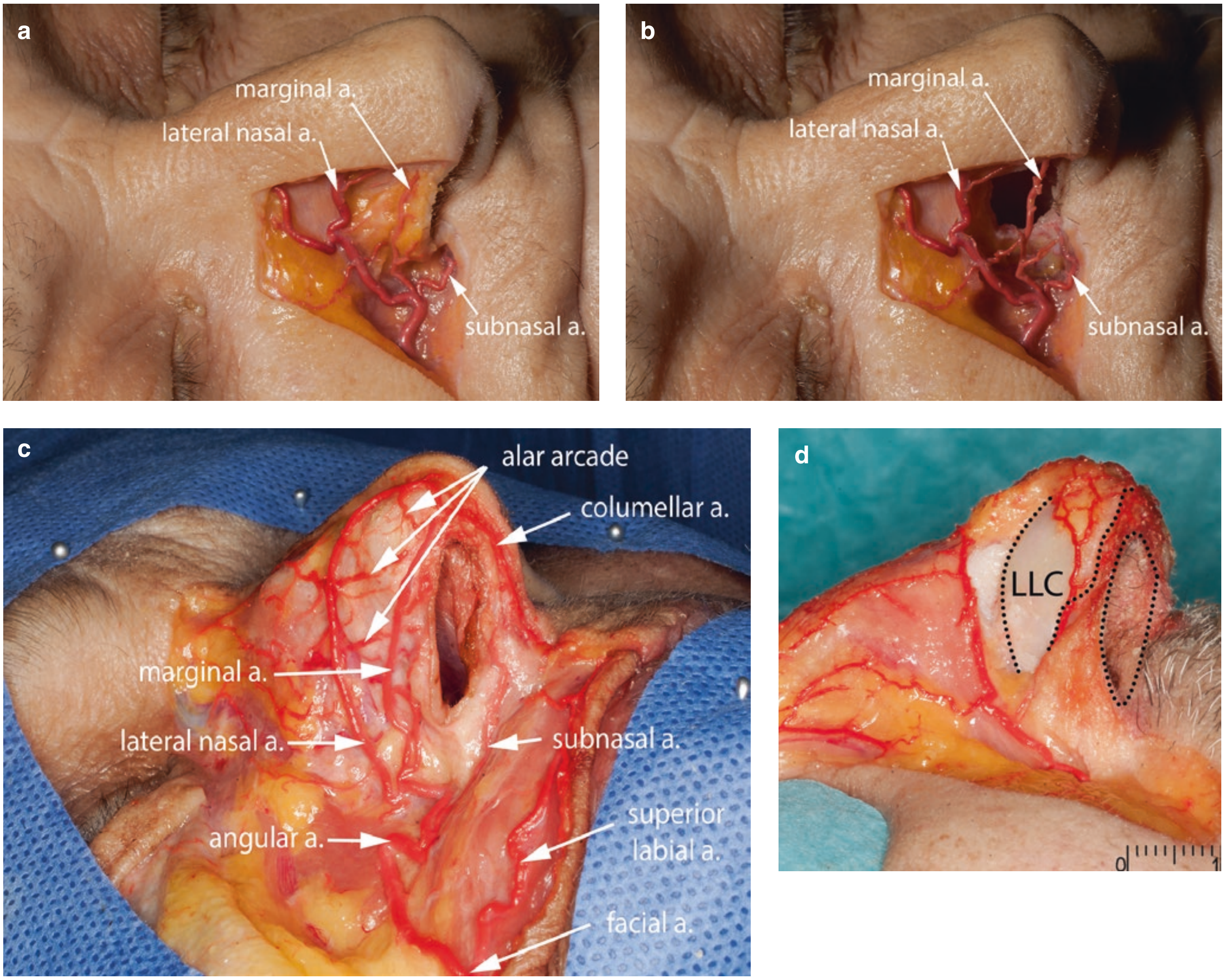


Fig. 5.6 (**a**–**d**) Vascular blood supply to the nasal base. *LLC* lower lateral cartilage

Our injection studies confirm the arterial branching pattern from the facial artery to the angular artery to the lateral nasal artery (Fig. 5.6a–d). As beautifully illustrated by Saban et al. (2012), the **facial artery** runs to the oral commissure and continues along the upper lip before dividing into a lower branch, which goes across the upper lip as the **superior labial artery**, and an upper branch, which runs beneath the nasolabial fold as the **angular artery**. The superior labial arteries give the paired columellar arteries to the columella; these anastomose with the lateral nasal artery in the nasal tip area. The angular artery sends branches beneath the alar lobules. The first branch is the **subnasal artery** beneath the nostril sill; then comes the **lateral nasal artery**, which usually has two branches above and below the lateral crus. Between these two branches, arterial communicating branches create the **alar arcade**.

(AREA 1) COLUMELLAR BASE

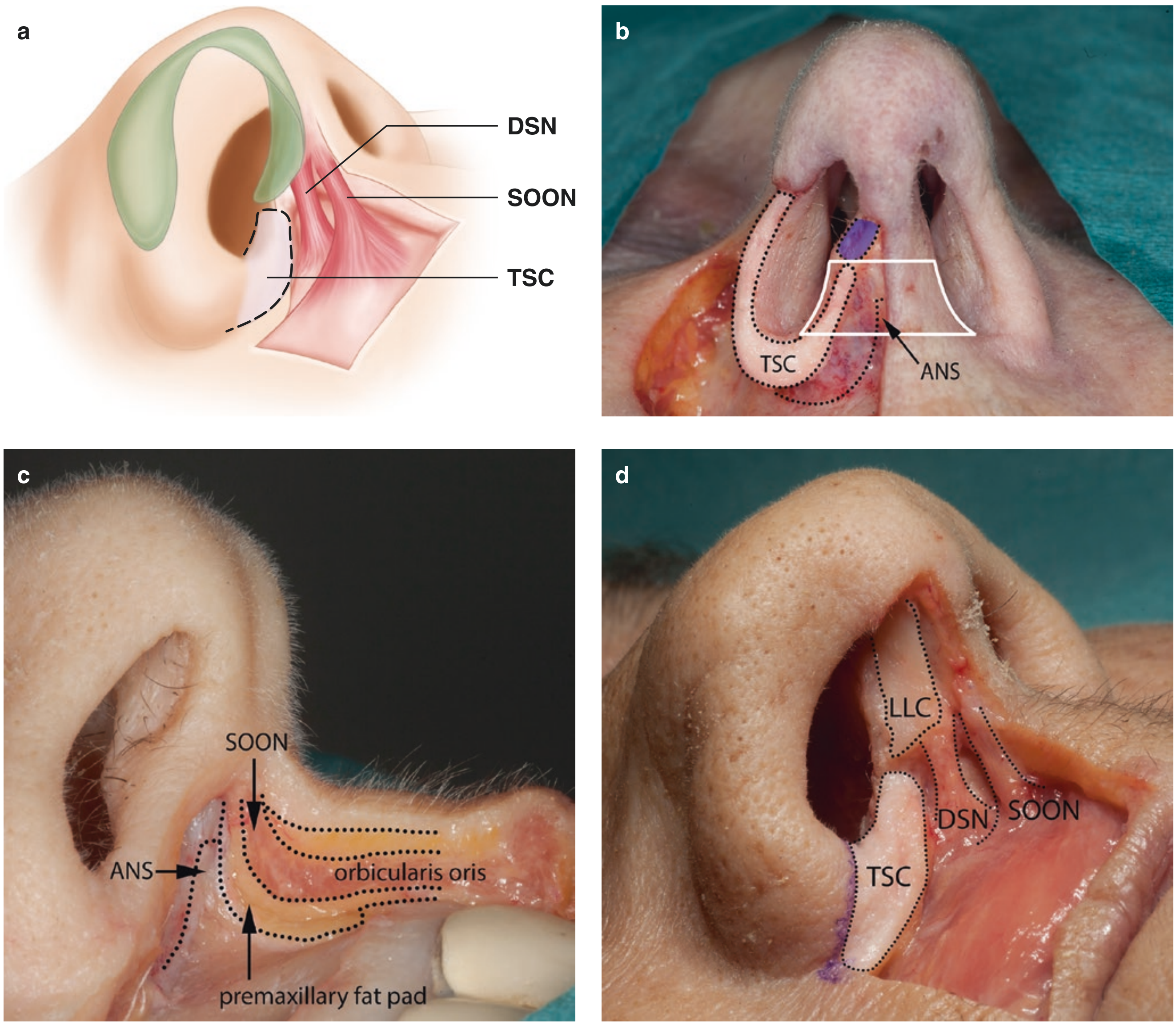


Fig. 5.7 (**a**, **b**) The columellar base extends from footplates down to Sn (subnasale). (**c**) Premaxillary fat pad is between the paired depressor septi nasalis (DSN) and underneath the superficial orbicularis oris nasalis (SOON). (**d**) Muscles that act on the columellar base include the DSN and SOON. Note the medial progression of the tela subcutanea cutis (TSC), which extends into the columellar base

The ***columellar base*** is a complex soft tissue area that has received minimal attention until recently (Daniel et al. 2013). It has rarely been recognized as a distinct entity or defined. We consider the columellar base to extend from the bottom of the footplates down to a line drawn through the nostril sills (Fig. 5.7). Unlike cartilaginous structures with specific landmarks, the columellar base is a soft tissue structure composed of multiple parts (Fig. 5.8). In the midline, the subcutaneous fat is split on either side of muscle tissue running upward from the lip as the superficial orbicularis oris nasalis (SOON). On either side, the depressor septi nasalis muscle (DSN) runs upward. Laterally, the tela subcutanea cutis (TSC) widens the columellar base. Obviously, its vertical height is influenced reciprocally by the footplates, being longer when the footplates are shorter, and the amount of soft tissue varies dramatically.

(AREA 1) COLUMELLAR BASE

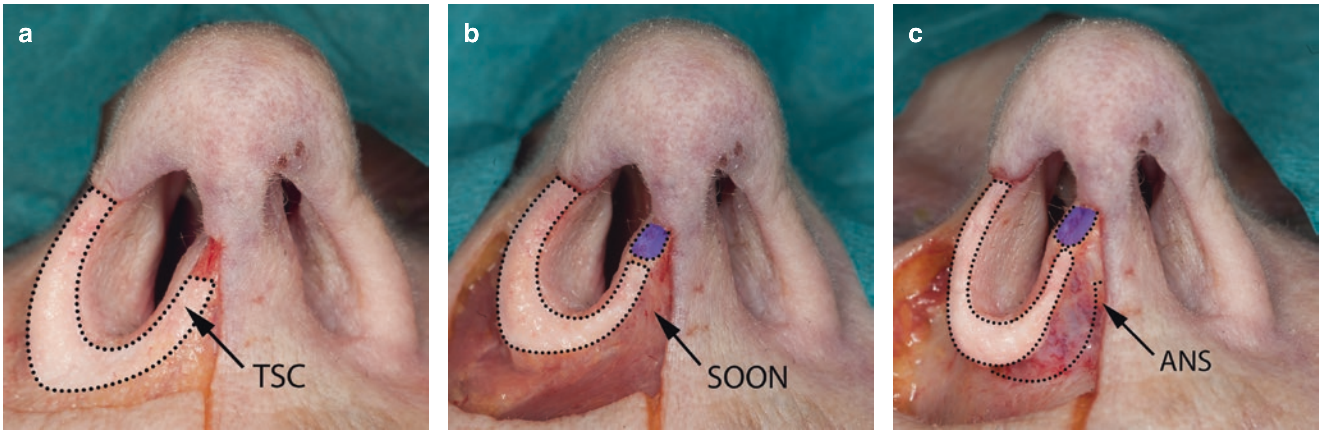


Fig. 5.8 Layers of the columellar base. (**a**) Tela subcutanea cutis (TSC) and subcutaneous fat. (**b**) Superficial orbicularis oris nasalis (SOON). (**c**) Anterior nasal spine (ANS)

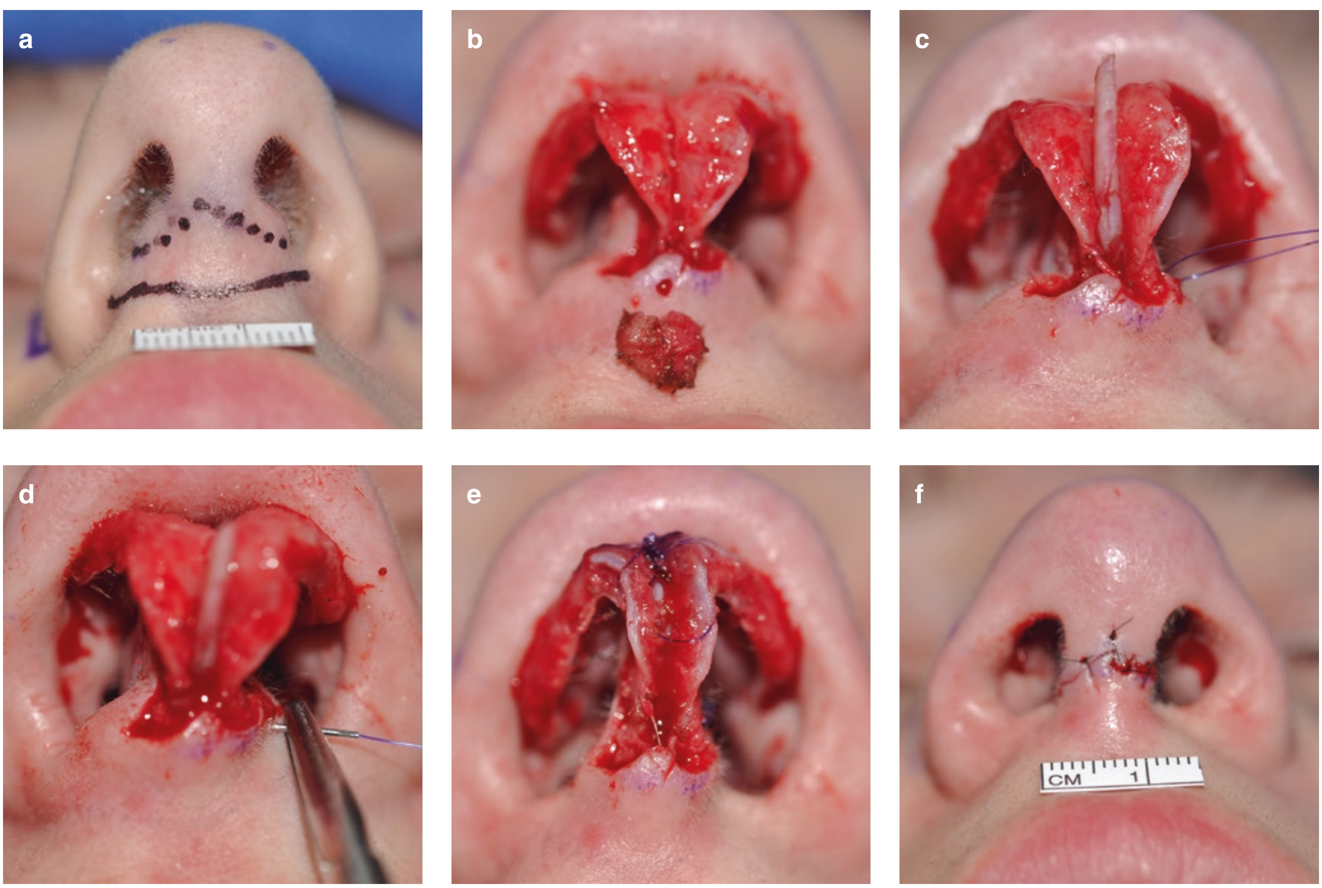


Fig. 5.9 Narrowing the columellar base. (**a**) Analysis shows the *columellar base* between the junction of the footplates (*dotted line*) and the level of the nostril sills (*solid line*). (**b**, **c**) Step one is to excise the intervening muscle tissue comprised of DSN and SOON. Step two is to mobilize the footplates and suture them to the columellar strut). (**d–f**) Next, the skin is slid cephalically onto the caudal septum, fixed with straight needles, and sutured with 4-0 PDS

Narrowing and reshaping the columellar base require a sequential approach, as illustrated in Fig. 5.9. The result is a narrower columellar base that does not impinge onto the external nostril valve.

COLUMELLAR BASE (CASE STUDY)

Analysis: A 16-year-old girl of Persian descent requested a rhinoplasty to achieve a smaller, cuter nose. It was explained to her that her thick skin envelope would limit the amount of improvement. The patient did not complain of nasal obstruction, despite the collapse of her external valve on deep inspiration (fig. 5.11j). On basilar view, the primary problem was the wide columella and secondarily the weak alar side walls. Anatomically, her medial crura were short and her columellar base was filled with soft tissue.

Operative Technique: Columellar base narrowing required a two-step maneuver (Fig. 5.10): excision of the intervening soft tissue, predominantly muscle, followed by shifting of the skin cephalically, similar to a tongue-in-groove.

1. Elevation of soft tissue envelope (STE) in subdermal plane followed by maximum soft tissue excision.
2. Minimal dorsal resection (b 0.5 mm, C 2.8 mm) followed by a septal harvest.
3. Graft preparation: columellar strut, open structure tip, alar rim structure (Fig. 5.10b).
4. Muscle excision from columellar base. Suture of medial crural footplates to columellar strut (Fig. 5.10c).
5. Insertion of open structure tip graft and a cap graft behind it (Fig. 5.10d).
6. Closure followed by insertion of alar rim structure graft (ARS) along a true marginal incision (Fig. 5.10e).

Commentary: At the end of the operation, the columellar base had been narrowed from 15 to 8 mm. Essentially, one could divide the columella into an upper third (nostril apices), middle third (medial crural footplates), and bottom third (columellar base). The footplates had been sutured to the columellar strut, ensuring effective narrowing. As seen at 4 years postop (Fig. 5.11), the patient is better and her external valve no longer collapses on deep inspiration (Fig. 5.11k).

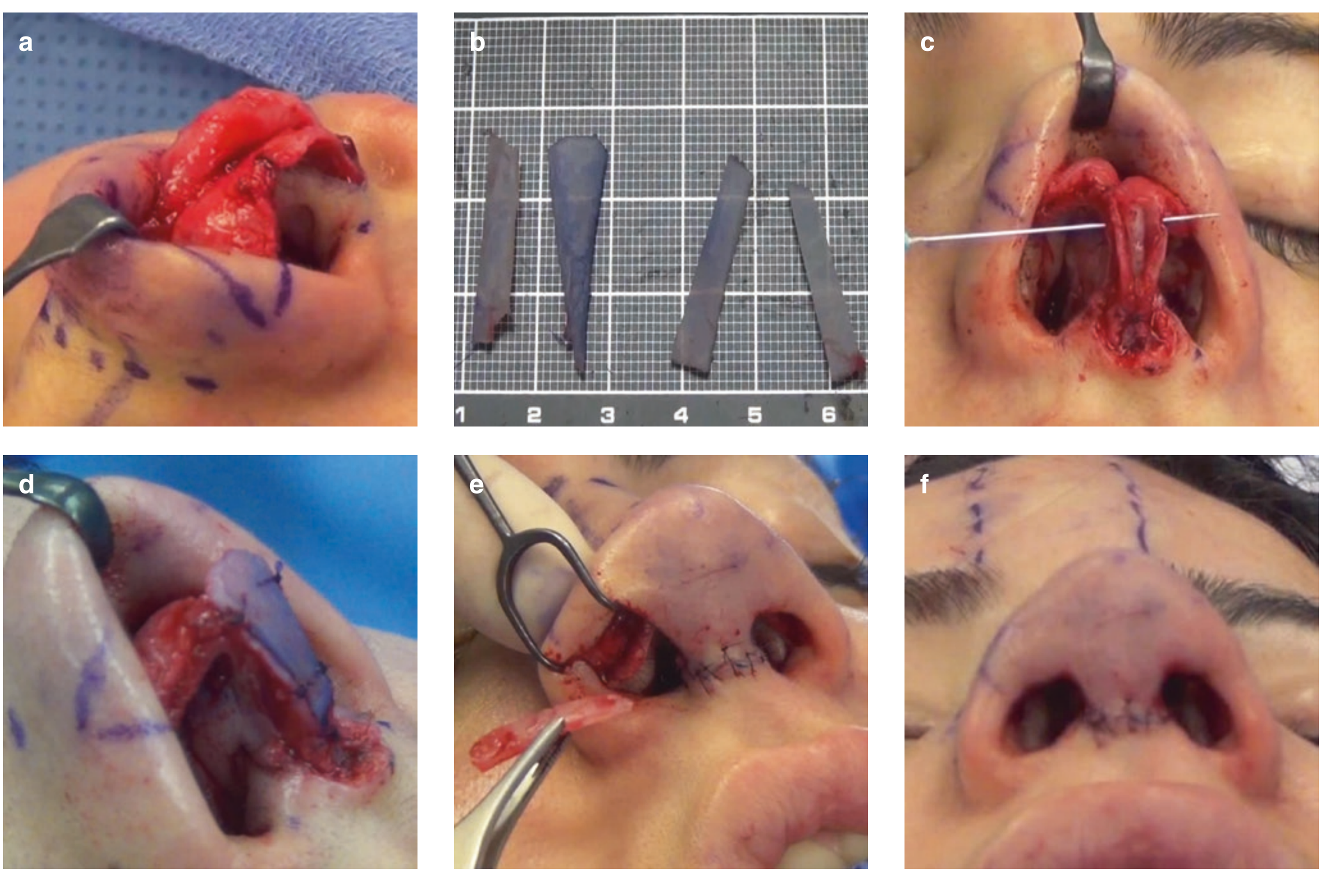


Fig. 5.10 (**a–f**) Operative technique for columellar base narrowing

COLUMELLAR BASE (CASE STUDY)

Fig. 5.11 (**a–k**) Patient before and 4 years after surgery to narrow the columellar base

(Areas 2 and 3) c′ and Infralobule

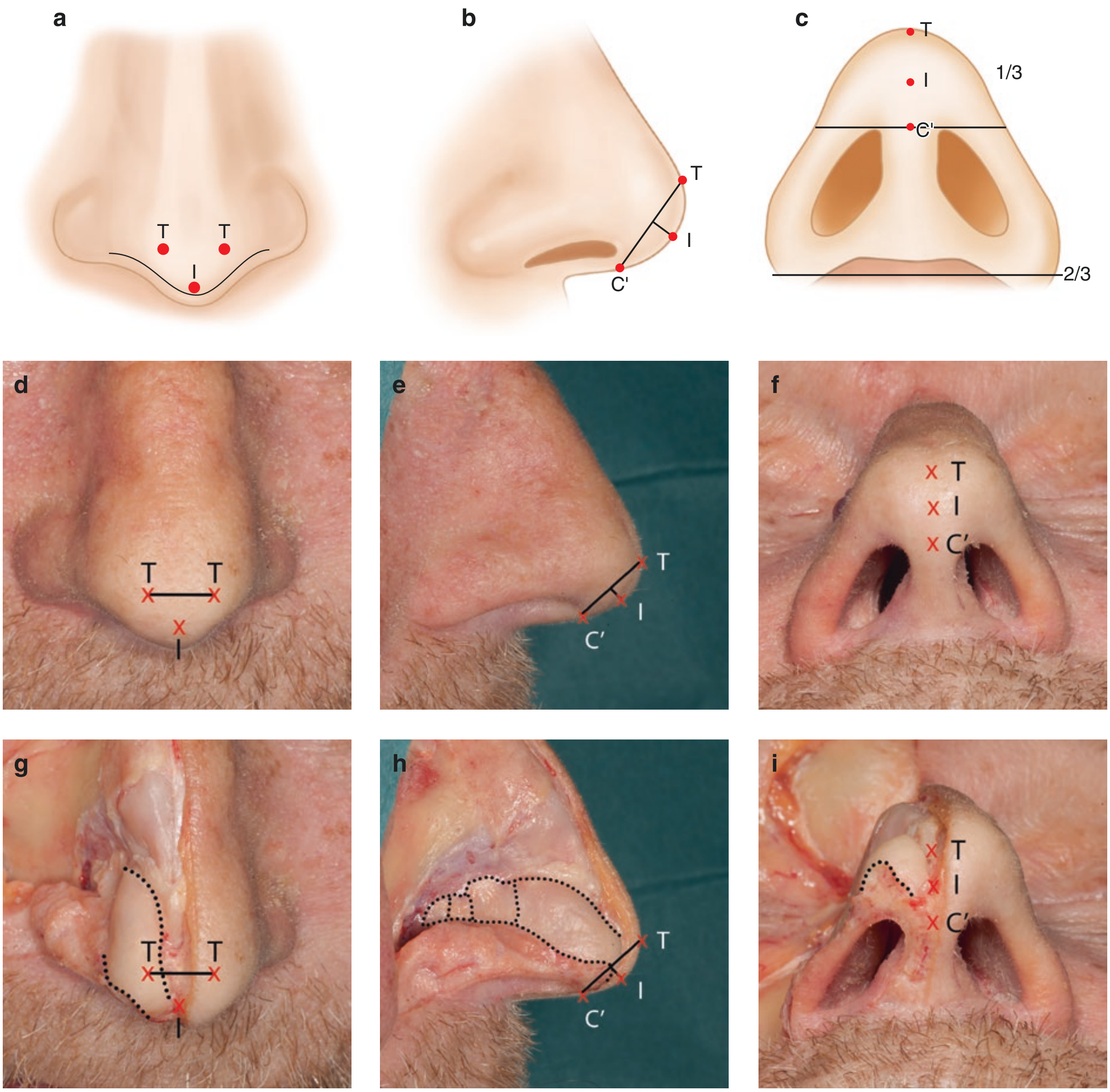


Fig. 5.12 (**a–i**) Infralobule anatomy. c′—columellar breakpoint; I—infralobule prominence; T—tip-defining points

Aesthetics and analysis of the infralobule are complex because of their derivation and imprecise definitions. Sheen (1978) initially thought of the tip as two equilateral geodesic triangles with a common interdomal base; the inferior point was the columellar-lobular junction. In 1992, Daniel pointed out that Sheen's concept was excellent for surface aesthetics but did not translate to the underlying anatomy. It was emphasized that "the infratip triangle widens to a trapezoid infralobular segment with the facets of the soft-tissue triangles added in triptych fashion and angled cephalically" (Daniel 1992). It was emphasized that the columellar-lobular junction occurred at c′—the *columellar breakpoint* between the columellar segment of the medial crus and the infralobular segment of the middle crus. Subsequent studies have defined the relationship of c′ to the top of the nostrils; 90% fall within +1 to −2 mm. The *infralobule* was defined as the area between c′ and T, with a curved volume and a prominence at "I" that often corresponds to the medial genu of the domal notch (Fig. 5.12) (Daniel 2002). On anterior view, a line is drawn between the tip-defining points (T). On lateral view, one draws both I and c′. In primary cases, visibility of c′ on anterior view often indicates a hanging columella caused by extrinsic forces.

(AREAS 2 AND 3) C′ AND INFRALOBULE

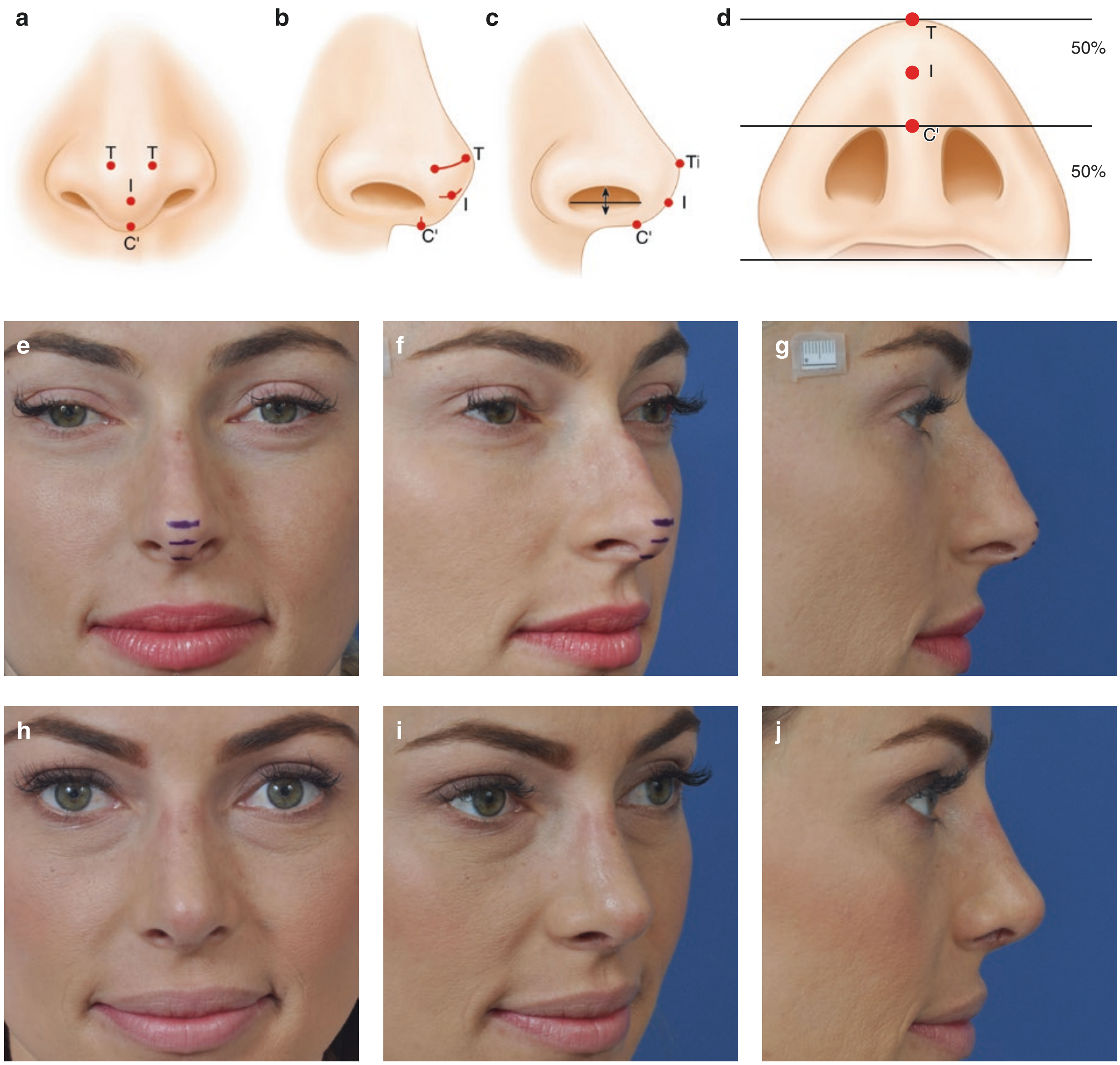


Fig. 5.13 (**a–c**) The hanging columella with its three "seagulls." (**d**) 50–50 distribution of columellar and infralobule. (**e–g**) Primary patient with hanging columella. (**h–j**) The same patient after surgery

As shown diagrammatically, one can see a shift in the wings of the "seagull "as one progresses from normal to slightly hanging to a full hanging columella (Fig. 5.13a–c). The primary patient shown in Fig. 5.13e–g illustrates the problem of a hanging columella from all three views. On lateral view, it is obvious that c′ is below the nostril apex by 2 mm, and that on the anterior view one sees c′ rather than I. After surgery (Fig. 5.14h–j), c′ is at the top of the nostrils and is no longer visible on the anterior view. In many secondary noses, the hanging columella can be caused by multiple factors that result in a "landing seagull" deformity. Essentially, one is seeing a posteriorly displaced c′, often plus small nostrils combined with retraction of the alar rims. The result is an excessively long infralobule (c′–T) which often requires moving c′ higher and lowering T to achieve a more aesthetic tip. If one closely examines the two anterior views (Fig. 5.13e, h), one sees that there are three seagulls preoperatively and only one postoperatively. On the preop photos, we see "I" as relatively straight, with the major seagull at c′ and further accentuation at Sn, extending along the nostril sills. On the postop photo, there is only one seagull, which is now located at "I".

c′ and Infralobule (Case Study)

Analysis: A 19-year-old woman presented for a secondary rhinoplasty 3 years after her primary procedure. Essentially, she hated her profile, especially the tip. Her STE was extremely thick. Analysis revealed a columellar inclination of 75° (ideal 103°), short nostrils with a round nostril apex, and a c′ 4 mm below the nostril apex (Fig. 5.14a–c). The lobular curvature was extremely long (24 mm: 14 mm c′ to T and 10 mm T to S (supratip point)).

Operative Technique:

1. Open approach at the subdermal plane followed by maximum soft tissue defatting (4+ mm).
2. Cart vault resection 3 mm followed by insertion of a diced cartilage in fascia (DC-F) graft to the dorsum (33 × 1.5 mm).
3. Excision of caudal septum: 3.5 mm at CP and tapered to 2 mm at ASA.
4. Insertion of a columellar strut with advancement of the alar cartilages. Tip suture (CS, DC, ID, TP).
5. Add-on tip refinement graft (shield shape) of excised alar cartilage.

Commentary: At 1 year postop, the columellar inclination is now 100°, c′ is at the nostril apex, and the lobular curvature is much shorter (Fig. 5.15). Tip definition is more obvious and the supratip fullness is gone. The DC-F graft unified the two skin sleeves.

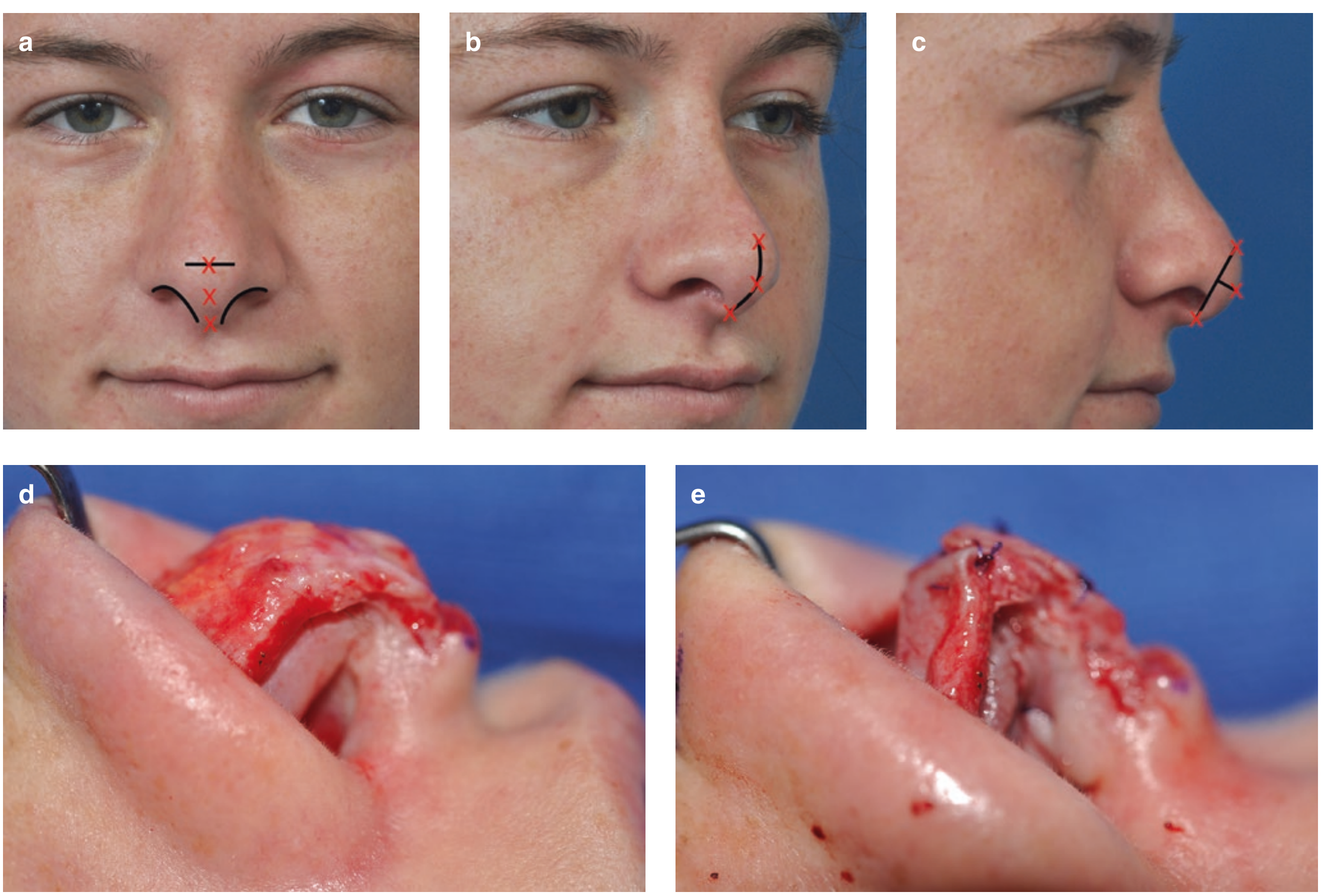


Fig. 5.14 (**a–e**) Infralobule modification

C′ AND INFRALOBULE (CASE STUDY)

Fig. 5.15 (**a–j**) Patient before and 1 year after infralobule modification surgery

(AREA 4) SOFT TISSUE FACETS

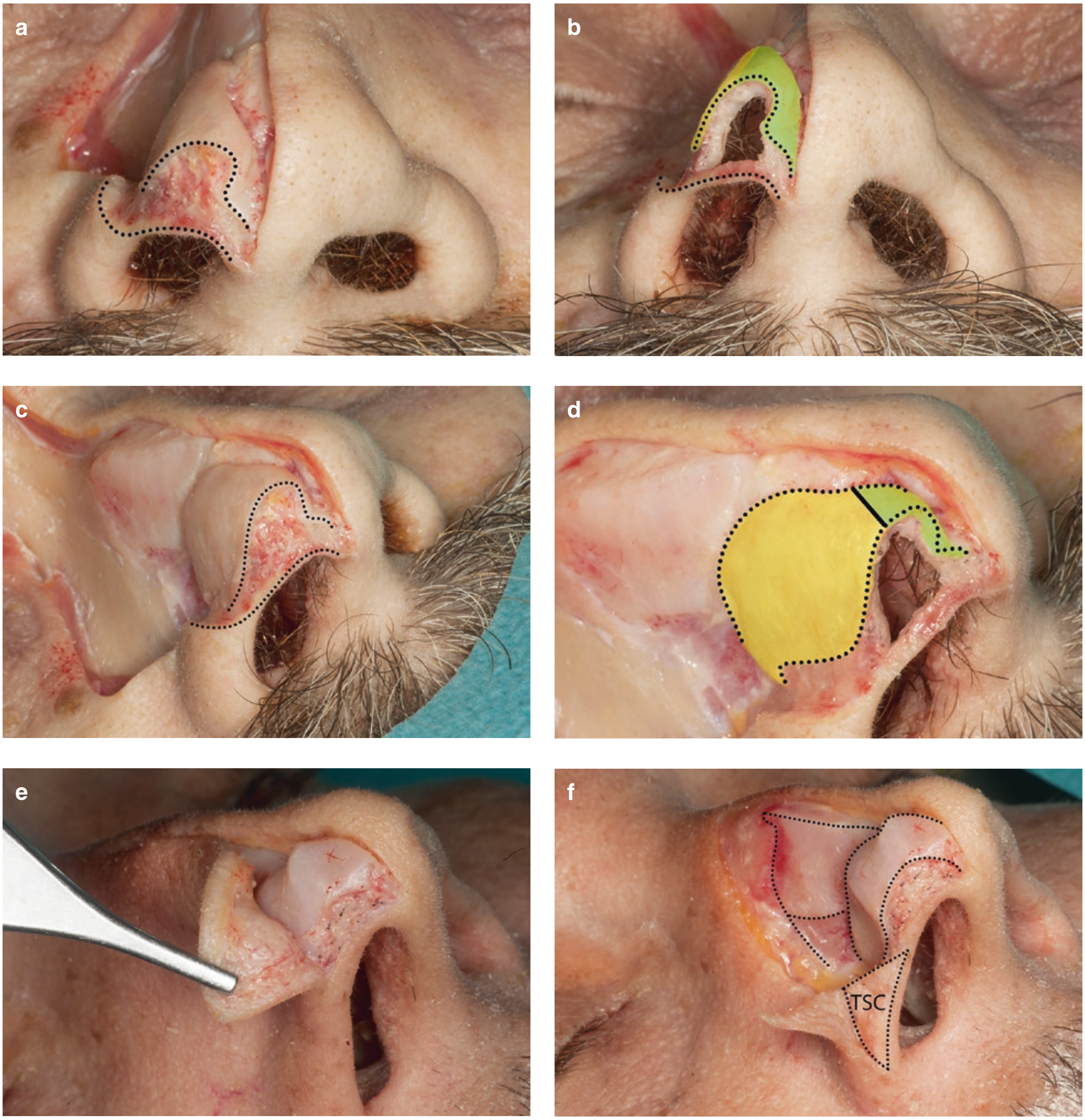


Fig. 5.16 (**a**–**f**) Soft tissue facet

Aesthetically, the soft tissue facet (STF) is the surface expression of the domal notch in the average nose (Fig. 5.16). Anatomically, the STF reflects the entire middle crus, beginning at the columellar breakpoint (c′) and continuing into the medial half of the lateral crus. The skin cover begins at the nostril rim, which is essentially the only place in the body where "skin abuts skin," although some may find small muscle fibers on histological examination. Essentially, there is no cartilage within the STF skin cover, although a thin layer of the superficial musculoaponeurotic system (SMAS) is interposed between skin and mucosa. Behind the STF is the atrium of the vestibule, which is usually 6–8 mm in height in the Caucasian nose; in secondary noses, it is often found to be obliterated by scar tissue. The STF is often hidden in patients with thick skin but is readily apparent in those with thin skin.

(AREA 4) SOFT TISSUE FACETS

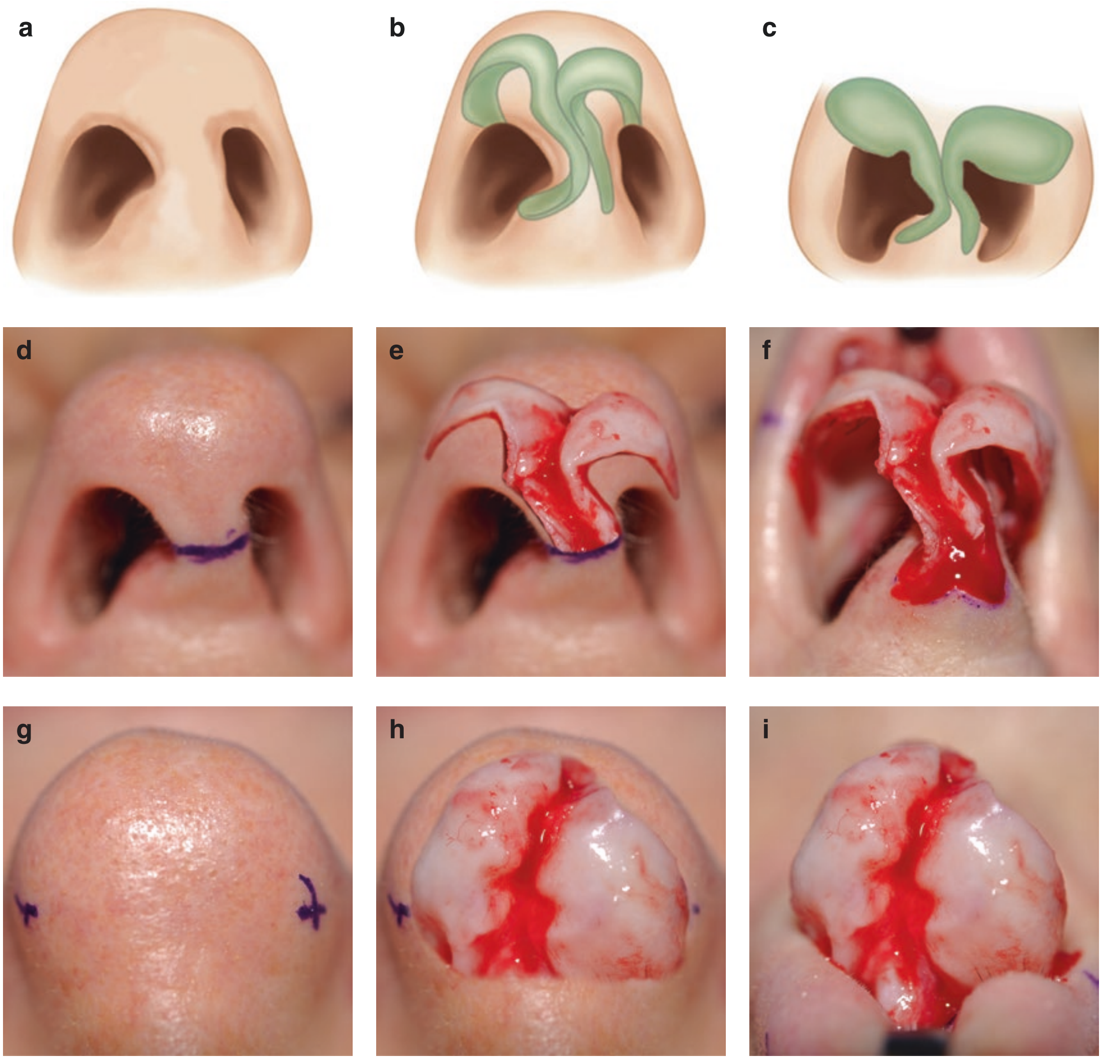


Fig. 5.17 (**a–i**) Asymmetric soft tissue facets with paradoxical middle crura. Note: Figs 5.17 (**b**, **e**, **h**) are "ghost" overlays of the underlying anatomy on to the overlying skin envelope

Most surgeons are unaware of the tight linkage between the STFs, alar anatomy, and nostril apices. Anatomically, the perimeter of the middle crus and the caudal border of the lateral crus directly determine the shape of the STF and the nostril apices, often in a paradoxical relationship. If one looks at the nostrils on preoperative basilar photos, it is logical to think that the domal notch would be narrow on the side of the tapered nostril apex and wide on the rounded nostril apex, but following skin elevation, the exact opposite is true (Fig. 5.17d). One can see on the tapered, pinched side (left nostril, Fig. 5.17d–f), the columellar segment of the middle crus is vertically and medially displaced and continues into the wide, undefined domal segment with a lateral crus having normal cephalic orientation. In contrast, the round nostril apex (right nostril) reflects lateral displacement of the columellar segment of the middle crus, an arched domal notch, and a lateral crus with severe cephalic orientation. Thus, the etiology is the displacement of the medial genu relative to the midline, compounded by the orientation of the lateral crus. Although the STF is the capstone, the problem is created by the surrounding cartilages, beginning in the columellar segment, then the domal segment, and finally the lateral crus.

SOFT TISSUE FACETS, NOSTRIL APICES, AND ALAR RIMS

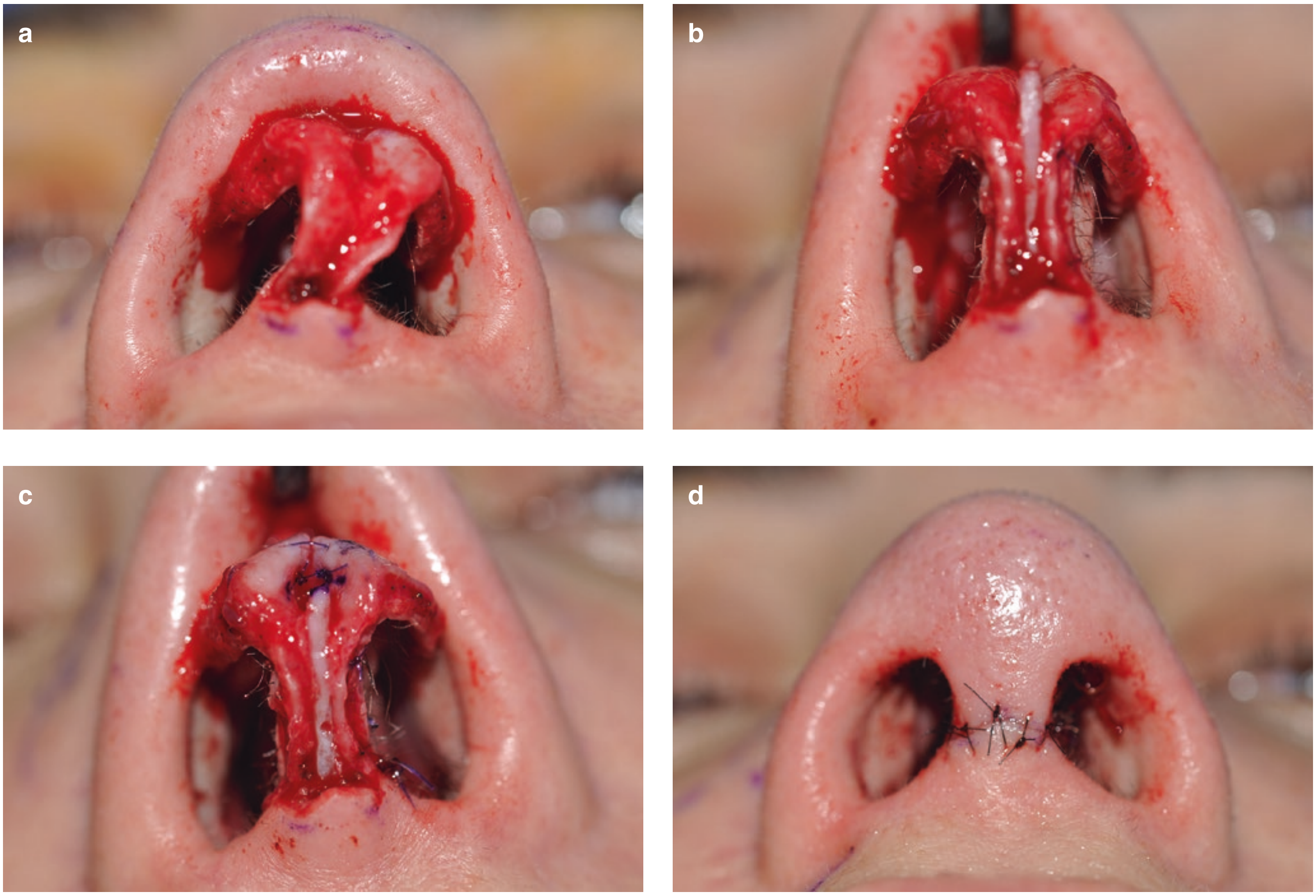


Fig. 5.18 (**a–d**) Asymmetry of the soft tissue facets and columella

In most cases, asymmetry of the soft tissue facets and columella are intrinsic to the alar cartilages. In Fig. 5.18a, there is a "triple reciprocal" deformity beginning at the footplates, then the lobular segments of the middle crura, and finally the domal segments. Improvement can be achieved by mobilizing the cartilages independently and then fixing them to a rigid columellar strut. As seen in Fig. 5.18b, the cartilages have been advanced separately and fixed below and above the columellar breakpoint with two columellar sutures. The cranial tip suture (Fig. 5.18c, d) has provided definition, expanded the STF, and raised the level of the caudal border.

When the asymmetry is more severe, it can be concealed with the use of STF grafts (STFGs), either standard or extended (see below). In the most severe cases, the only option may be a segmental excision at the level of the middle crus. It is important to place a solid columellar strut fixed below the level of the excision prior to any resection. The incision is done 3–4 mm above c′, and then the cephalic portion of the middle crus is brought down next to the strut. The inferior portion of the middle crus passes laterally, thus defining the upper portion of the medial nostril.

SOFT TISSUE FACETS, NOSTRIL APICES, AND ALAR RIMS

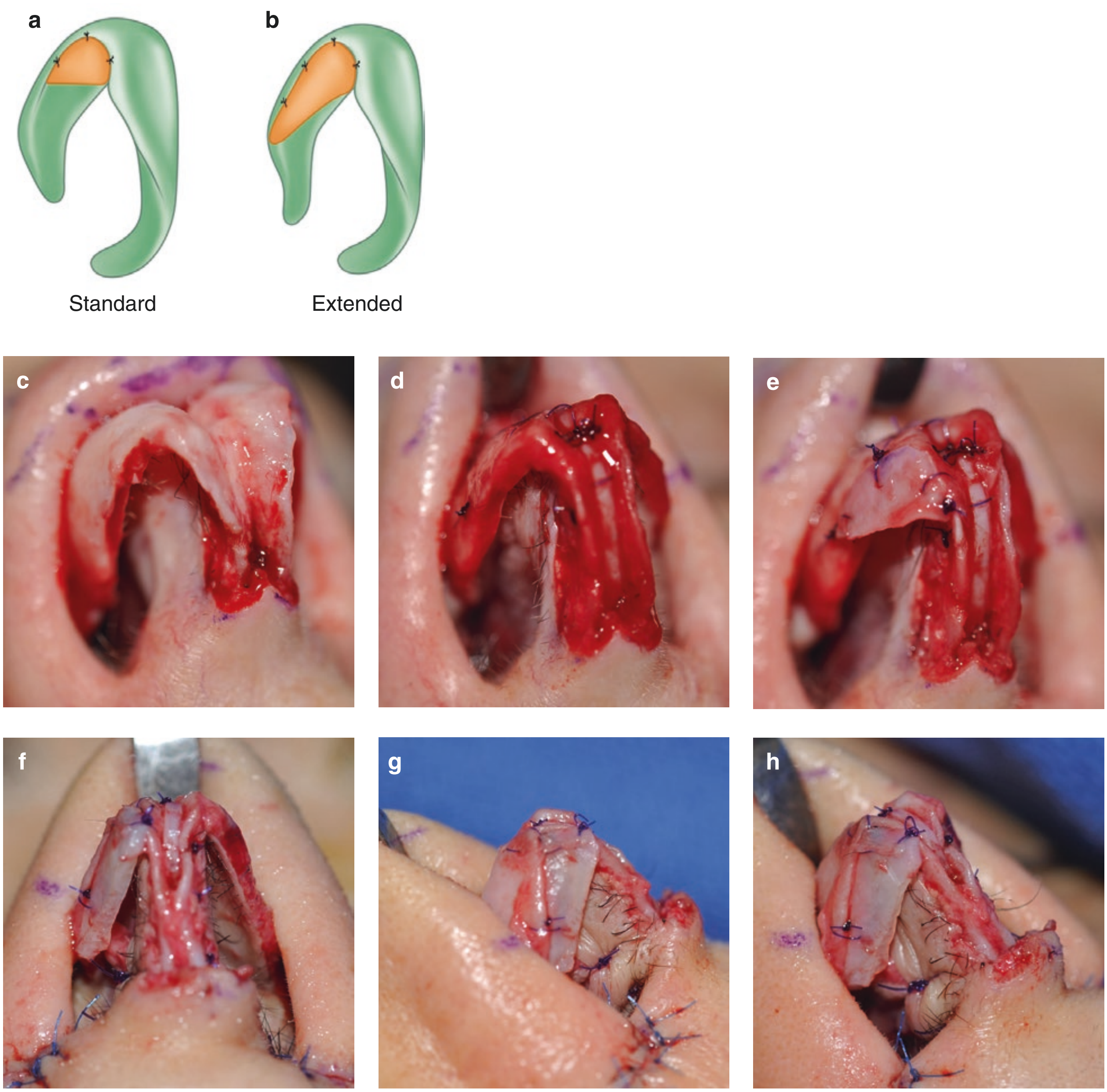


Fig. 5.19 (**a**, **c–e**) Standard soft tissue facet graft (STFG). (**b**, **f–h**) Extended STFG

STF grafts (STFGs) are an effective method of filling and supporting the facet area. We have developed two types of STFG: standard and extended. As shown in Fig. 5.19c–e, the ***standard STFG*** essentially fills the STF with cartilage and controls the shape of the infralobule. It also changes the "web" of the STF from concave to straight. In addition, the nostril apex is blunted and is no longer a sharp, narrow angle. The ***extended STFG*** (Fig. 5.19f–h) is significantly wider medially and tapers laterally. In this case, the medial portion was designed to overcome the cephalic domal displacement and bring the tip area downward. The lateral border was initially sutured to the caudal border of the lateral crus, but due to the severe alar malposition (9/16) it was elected to remove the lateral suture and create an alar rim pocket for the lateral end of the STFG. The goal is not only to fill the STF, but also to support the alar rim. At this time, there have been virtually no publications dealing with STF deformity and STFGs.

SOFT TISSUE FACETS (CASE STUDY)

Analysis: A 28-year-old woman felt that her nose was too big, with a bump on profile and a hanging columella. Analysis revealed a very large STF, compounded by a columellar inclination of 90°, c′ 2 mm below the nostril apex, and a long infralobule, all wrapped in ultra-thin skin (Fig. 5.20). Needless to say, the patient knew she didn't like it and the surgeon knew it would be a surgical nightmare.

Operative Technique:

1. Measurement indicated alar malposition (8 mm back from nostril rim; 16 mm nostril).
2. Very careful elevation of the STE reveals narrow alar cartilages. No cephalic lateral crus excision.
3. Major dorsal reduction (B 1.5 mm, C 6 mm). 6-mm caudal septal excision.
4. Septal harvest. Medial oblique and low-to-low osteotomies. Spreader grafts: R > L.
5. Columellar strut insertion. Tip sutures: CS, DC, ID, TP.
6. Suturing of standard STFG.

Commentary: At 1 year, the patient has a softer nose with nonvisible STFs. The hanging columella is gone, as is the overall "U-shape" of her tip (Fig. 5.21). The nose is more refined, with little evidence of surgery, and the "beakiness" on profile is gone.

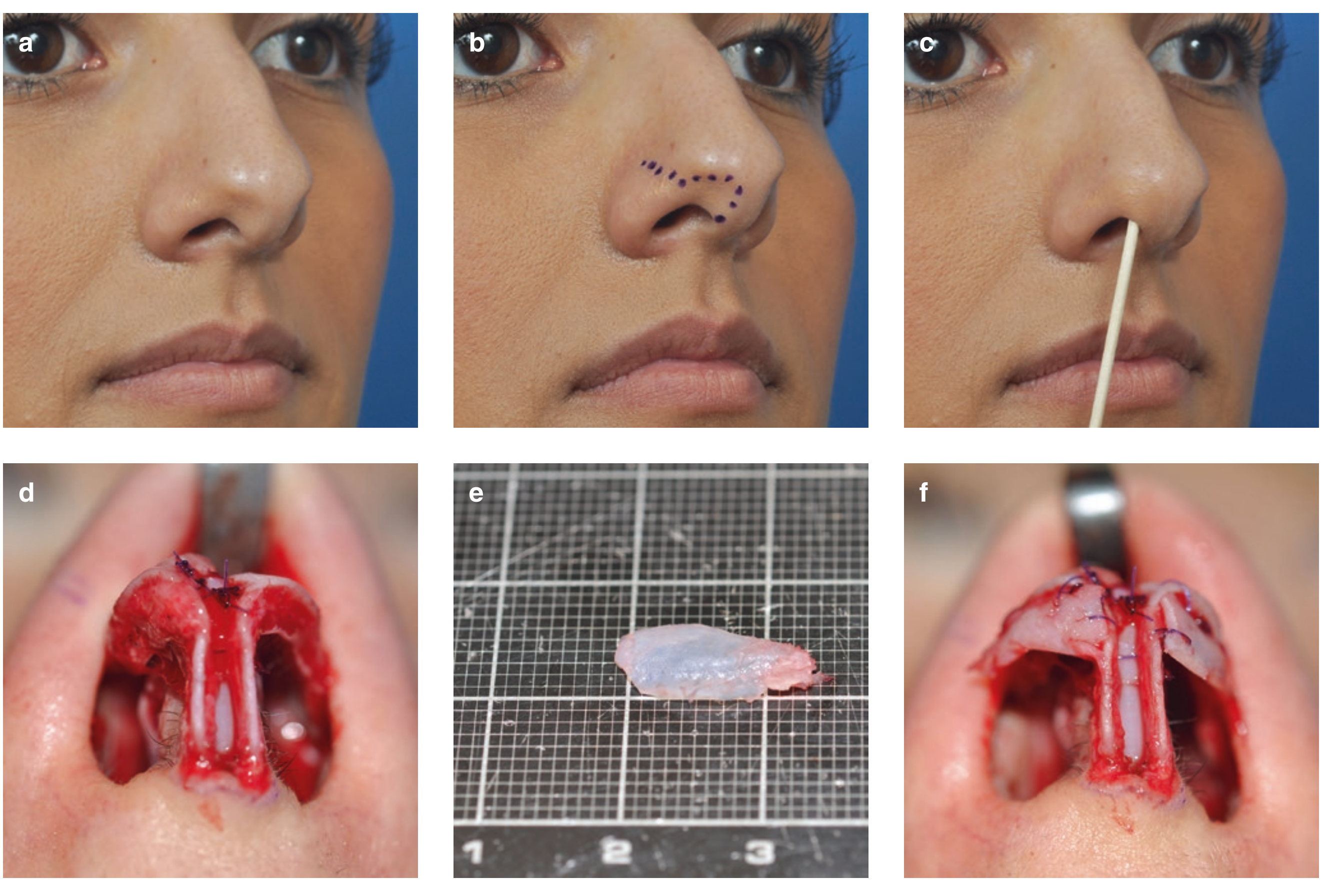


Fig. 5.20 (**a–f**) Standard STFG

SOFT TISSUE FACETS (CASE STUDY)

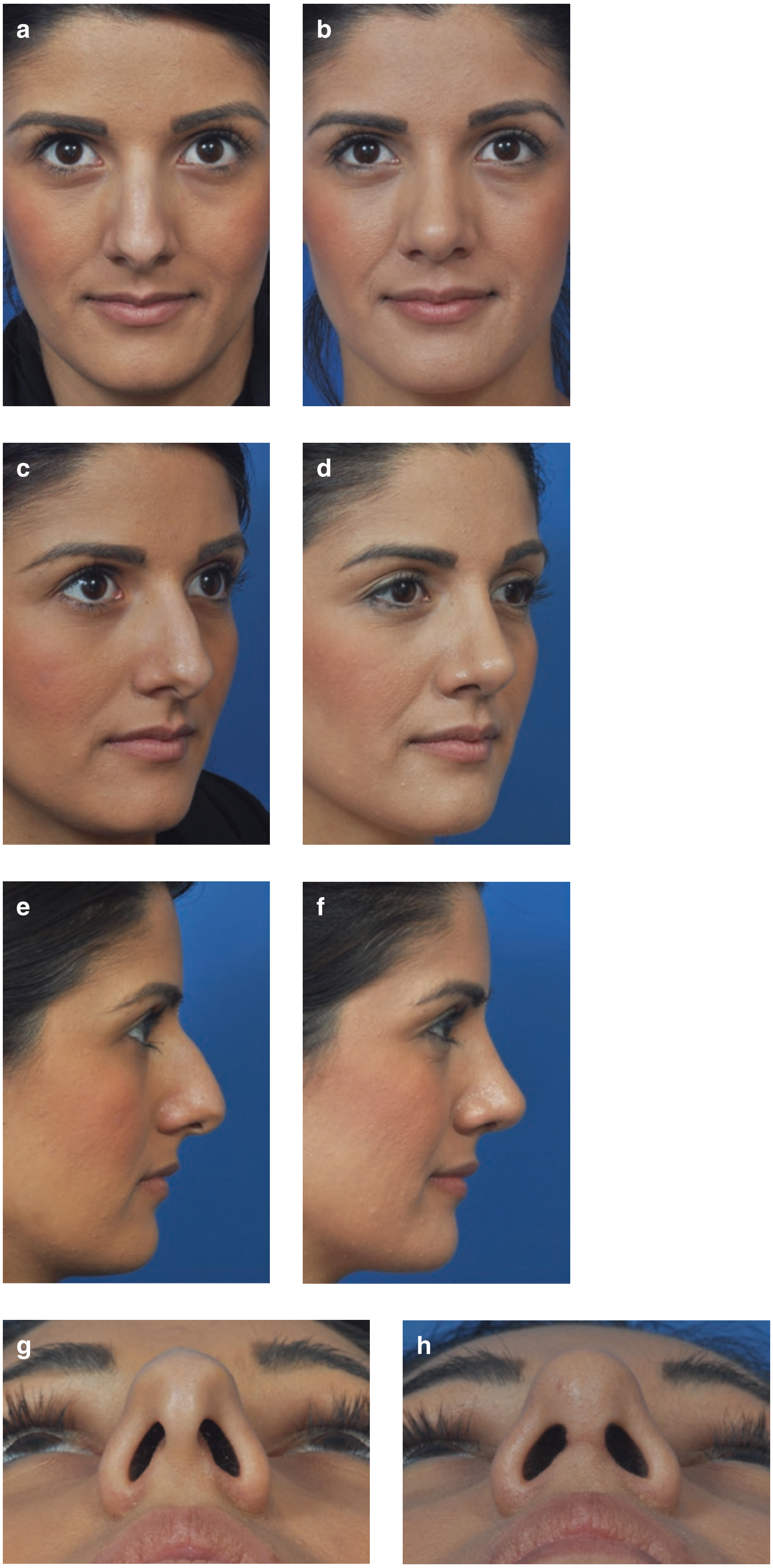


Fig. 5.21 (**a–h**) Patient before and 1 year after standard STFG

(AREA 5) ALAR RIM

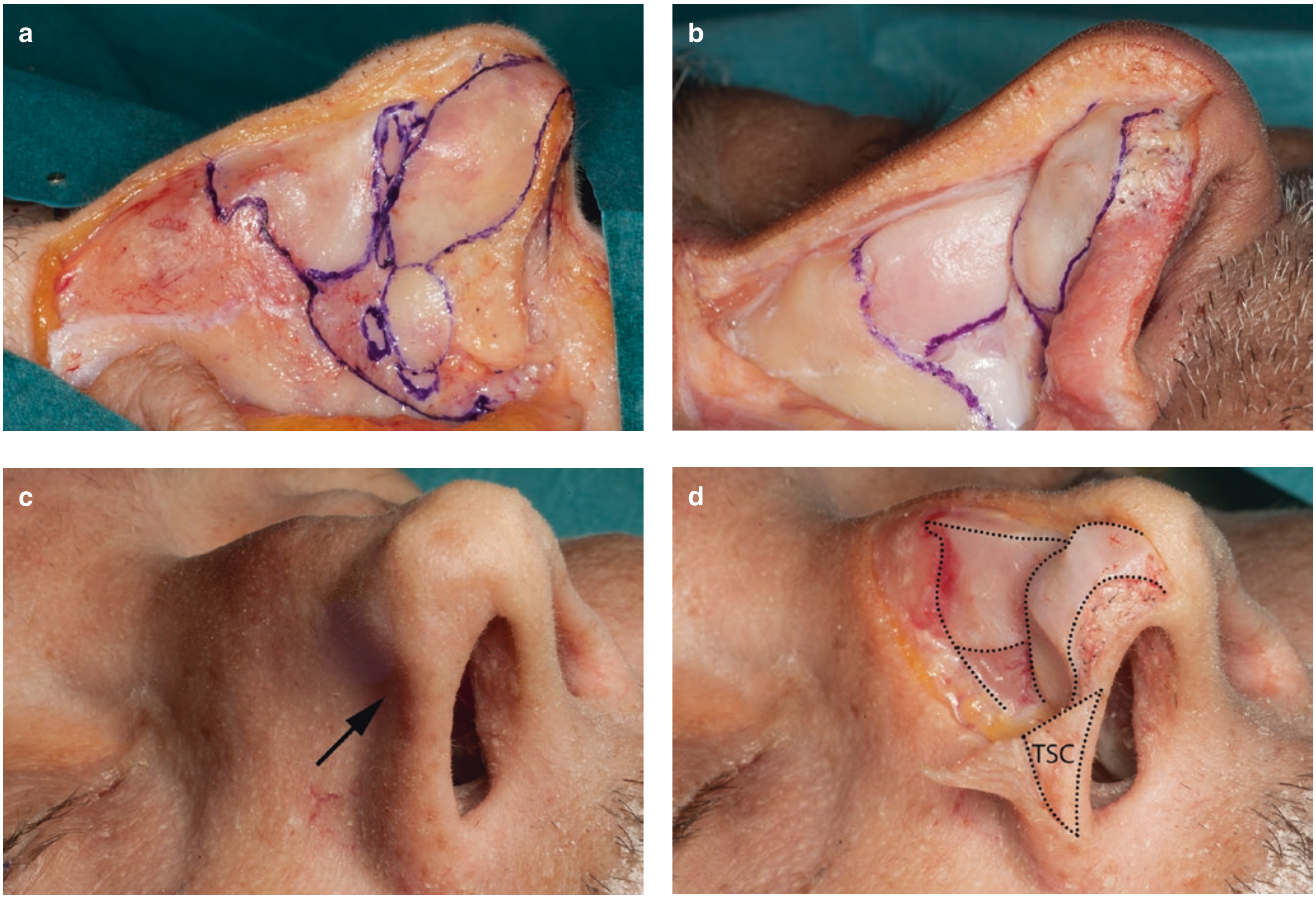


Fig. 5.22 Alar rim. (**a**, **b**) Significant difference in the relationship of the caudal border of the lateral crus to the nostril rim. External valve collapse is highly probable in (**b**). (**c**, **d**) Distinct junction point (*arrow*) between the cartilaginous cephalic portion and the soft tissue caudal portion

The commonly used term "alar rim" refers to the lateral nostril rim comprised totally of soft tissue. In its upper half it is associated with the alar cartilages, and in its lower half with the alar base. The two components are distinctly different from an anatomical and functional perspective, although they are often united surgically. The upper half is more rigid because of the adjacent cartilage, whereas the lower half is more prone to external valve collapse. It is important to note that the width of the alar rim can vary dramatically depending upon the width of the lateral crus and its relative position (Fig. 5.22a, b). One must remember that there is no cartilaginous component of the alar rim, no matter how often surgeons stuff it with cartilage grafts. Since the nostril rim is simply a fold of skin, we should accept that it is essentially a passive entity influenced by its adjacent structures—the alar cartilages and the alar base. The problems we encounter with the alar rim—whether aesthetic weakness and retraction or functional collapse—are caused by the adjacent structures. As noted in Fig. 5.22c, d, the weakness along the alar rim is related to the junction between the anterior convexity and posterior concavity of the lateral crus and is exacerbated by a weak alar base.

(AREA 5) ALAR RIM

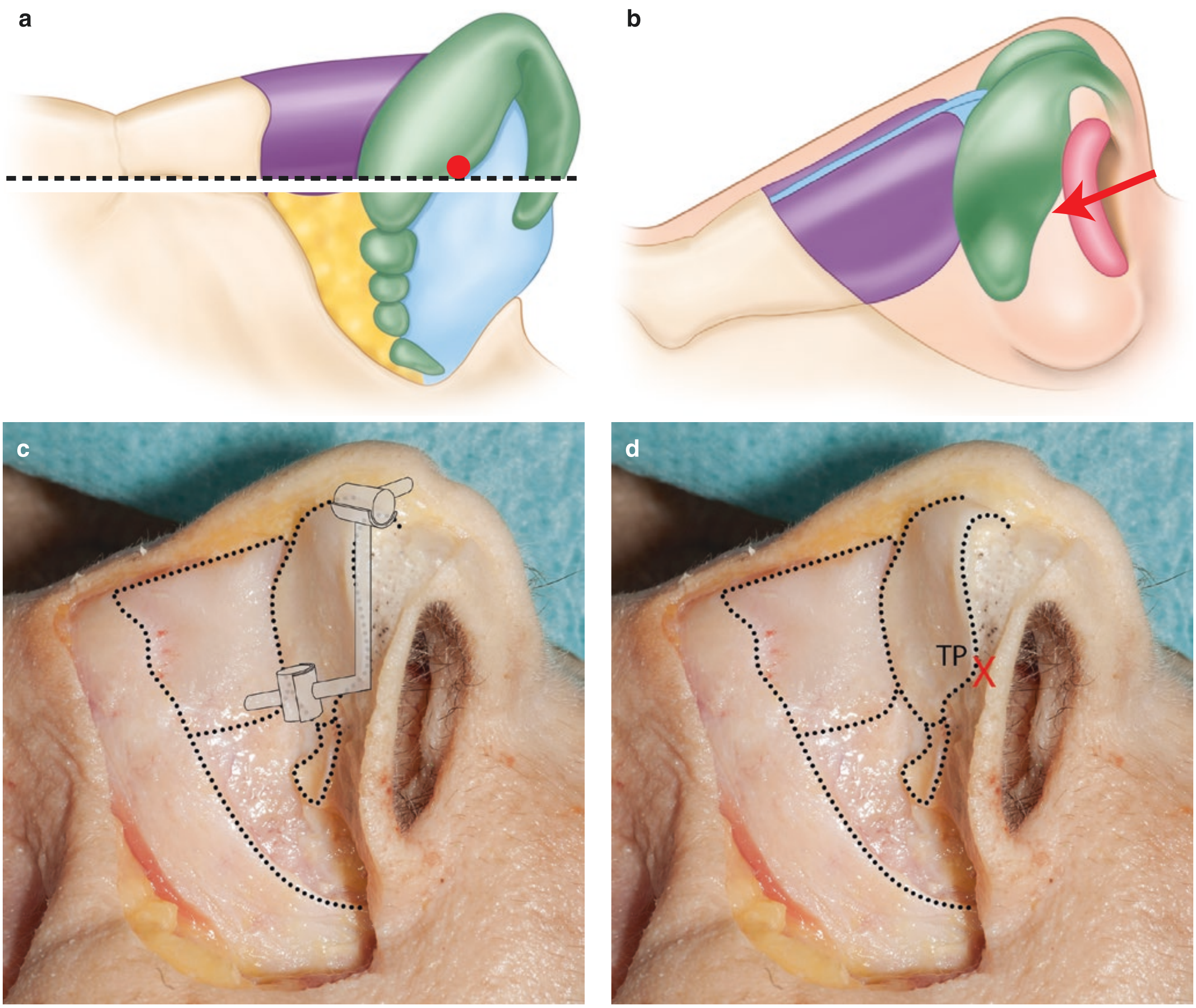


Fig. 5.23 (**a**, **b**) External valve collapse. (**c**, **d**) A "tension hinge" occurs at the anatomical junction between the stable, cartilaginous upper third and the collapsible, basilar lower two-thirds of the rim. TP—turning point of the lateral crus

Alar rim support is both static and dynamic and must be discussed within the context of the external valve. Static support is a continuous support of the alar rim, which helps to keep the nostril open during respiration. Dynamic support is provided by the numerous muscles and the SMAS that insert or derive their origin from the lateral crus. These muscles help to stabilize the nostril rim in both inspiration and expiration. We conceive of this area not as a vertical oval that collapses, but rather as a continuation of the lateral wall. It collapses as a "**tension hinge**" just inferiorly to the turning point of the lateral crus (Fig. 5.23). This tension hinge is between the stable anterior portion, supported along the broad STF formed by the middle and lateral crus, and the posterior alar base. As the airflow accelerates, there is a drop in the intraluminal pressure by the Bernoulli effect, which results in collapse of the nostril/external valve. It must be emphasized that there is no significant movement medially in the anterior upper third, but rather the collapse occurs in the unsupported posterior two thirds of the nostril.

ALAR RIM GRAFT AND ALAR RIM STRUT

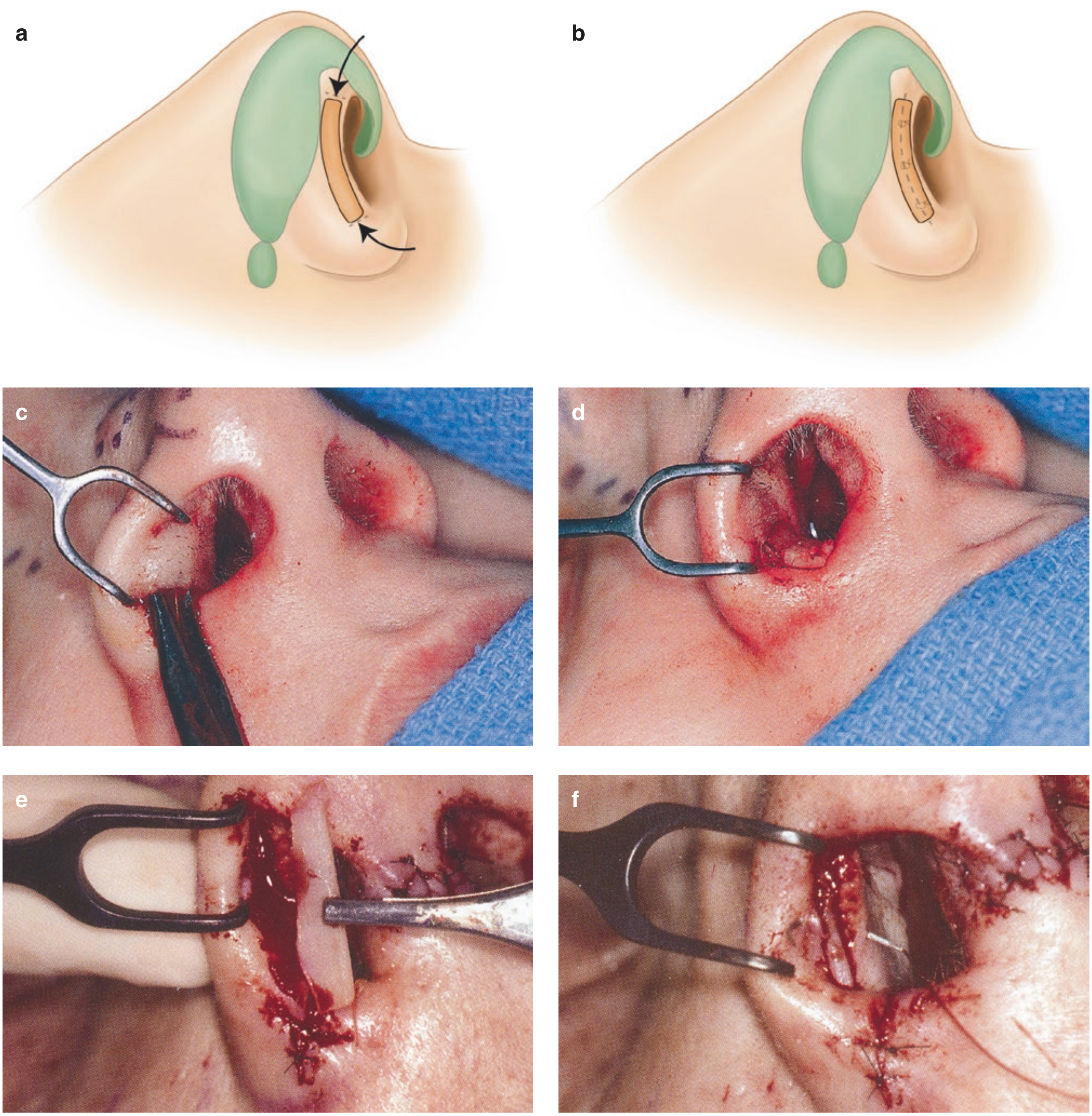


Fig. 5.24 Two types of grafts in the alar rim (**a**, **c**, **d**) alar rim grafts and (**b**, **e**, **f**) alar rim structure grafts

In 2002, Daniel introduced the *alar rim graft (ARG)* and the *alar rim structure graft (ARS)* for both aesthetic and structural support of the alar rims. The need for these grafts was related to alar rim weakness following domal creation sutures, which emphasized a convex dome adjacent to a concave lateral crus. This weakness along the rim emphasized the junction between the alar lobule and alar base and led to insertion of small pieces of stiff cartilage (12–14 mm × 3–4 mm) into subcutaneous pockets paralleling the alar rim via a medial or lateral incision (Fig. 5.24). The same cartilage graft could be sutured into a true "rim incision" 2 mm back from the alar rim as an ARS graft. The ARS is particularly helpful when one wants to change the intrinsic shape of the nostrils in primary cases or provide additional support in secondary cases. Subsequently, Toriumi (2006) defined an aesthetic highlight along the alar rim that could be accentuated with alar rim grafts sewn into pockets. Surgeons now have a wide range of choices, beginning at the alar rim for aesthetics and then working away from the rim for increasingly greater support.

ARTICULATED ALAR RIM GRAFT AND LATERAL CRURAL RIM GRAFT

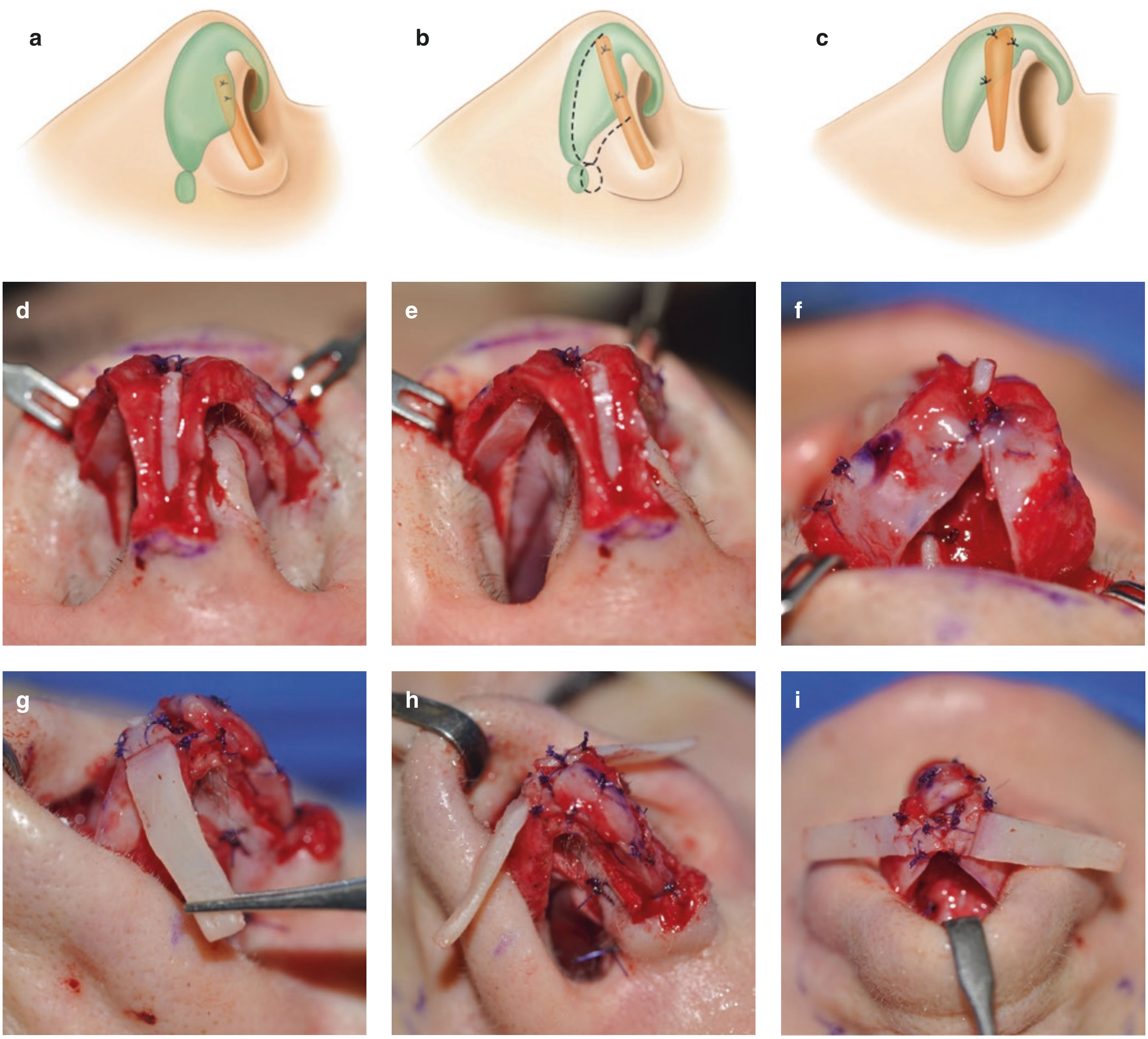


Fig. 5.25 Three types of strucutral grafts in the alar rim. (**a**) Lateral crural strut graft (LCSG) placed in the T3 position. (**b**, **d–f**) Alar rim strut graft (ARSG), and (**c**, **g–i**) Articulated alar rim graft

We have modified the lateral crural strut graft by placing it in the alar rim as an ***alar rim strut graft (ARSG***). As seen in Fig. 5.25, the graft is first placed into a subcutaneous pocket in the alar base, brought along the rim, and then placed under the lateral crus, thus providing structural support to the rim. The ***articulated alar rim graft (AARG)*** was devised by Davis (2015) to solve four potential problems: (1) to stabilize the alar rim and resist contraction; (2) to camouflage any inversion of the caudal border of the lateral crus; (3) to augment the poorly supported alar rim; and (4) to widen the tip caudally. The critical difference of the AARG from other rim grafts is that they are sutured to the tip adjacent to and flush with the dome (Fig. 5.25). The grafts drape at 90° paralleling the alar rim and are placed into pockets to support the alar rim or inserted under the lateral crus (Ballin et al. 2016). Obviously, these grafts must be highly tapered medially to avoid adding bulk to the tip. Unlike Davis, who uses these grafts as an integral part of his primary operation, we have found the AARG to be of greatest value in complex secondary operations.

ALAR RIM SUPPORT (CASE STUDY)

Analysis: A 46-year-old woman presented for a rhinoplasty. She did not like the overall size of her nose, its convexity, and the plunging tip. She also said "I still want to look like myself, only better." The nose was unattractive because of the static drooping of the nose, which truly plunged when she smiled. The alar rims were obviously weak, even though the caudal border of the lateral crus was at 5/20 mm. Ultimately, the profile change and shortening of the nose would only be partial improvement; the challenge was to profoundly change the tip (Fig. 5.26).

Operative Technique:

1. Tip exposure via an open approach. Cephalic orientation of alar cartilages at 61°.
2. Dorsal reduction (B 0.5 mm, C 4 mm at ASA). Caudal septal resection: 4 mm.
3. Septal harvest. Low-to-high osteotomies. Bilateral spreader flaps.
4. Insertion of columellar strut. Tip sutures: CS, DC, ID, DE, TP, LCCS.
5. Nostril sill excision (R, 3 mm; L, 2.4 mm).
6. Insertion of alar rim structure (ARS) grafts for rim weakness.

Commentary: This deformity was a challenge, as the amount of dorsal reduction and shortening of the caudal septum were moderate (Fig. 5.27). Thus, the change had to be in the tip. As seen in Fig. 5.26b, c, the cephalic orientation of 61° was reduced to 45° simply by *compressing the infralobule.* There was little if any cephalic lateral crus excision and no transposition. Ultimately, the alar rim structure grafts (ARS) would provide the necessary alar rim support.

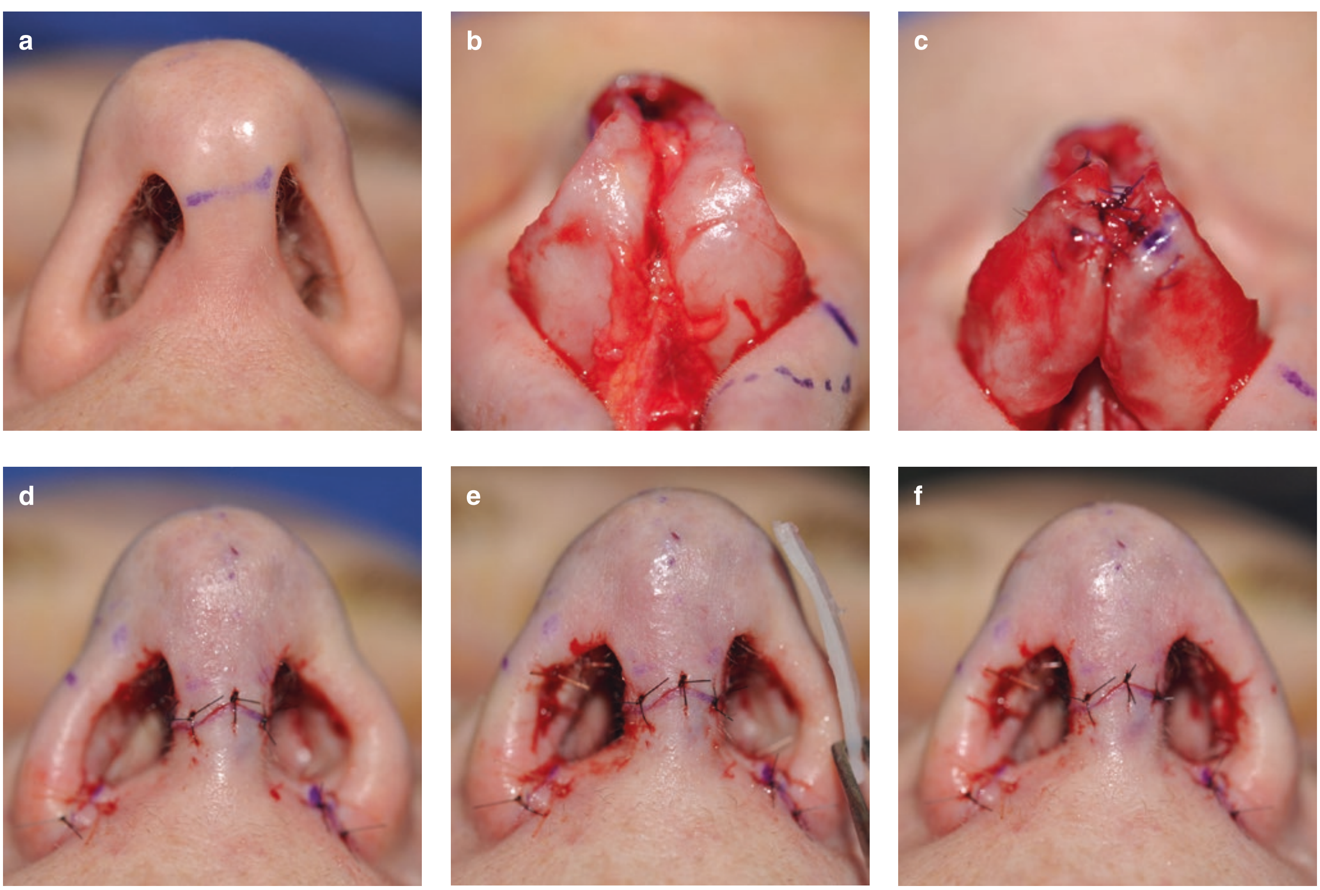


Fig. 5.26 Alar rim structure grafts: (**a**) preoperative view, (**b**) cephalic orientation of the lateral crura, (**c**) tip suturing, (**d**) right graft inserted, (**e**) 20 × 3 mm graft prior to insertion on left, and (**f**) following insertion on left

ALAR RIM SUPPORT (CASE STUDY)

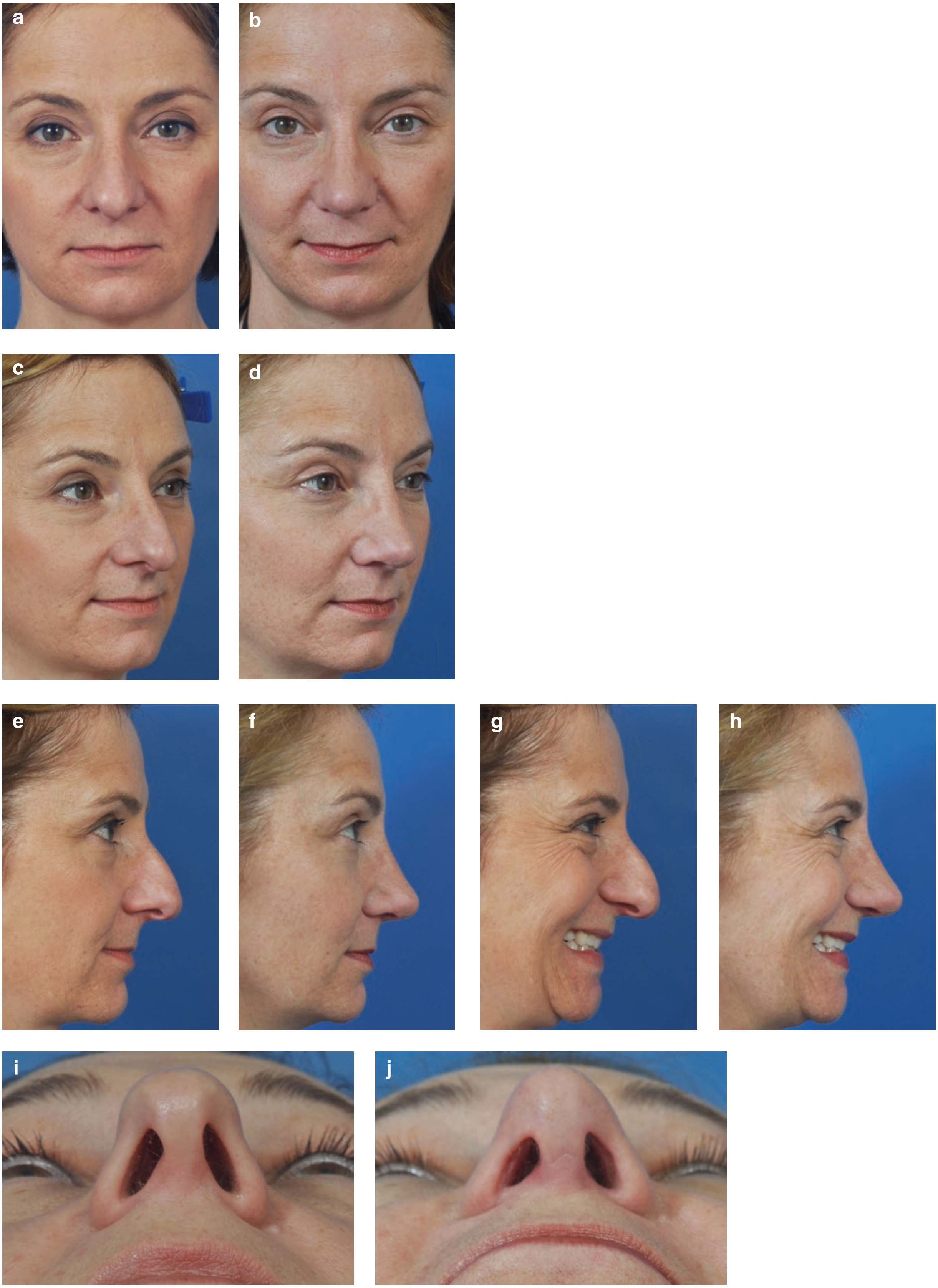


Fig. 5.27 (**a–j**) Patient before and after rhinoplasty

(AREA 6) ALAR BASE

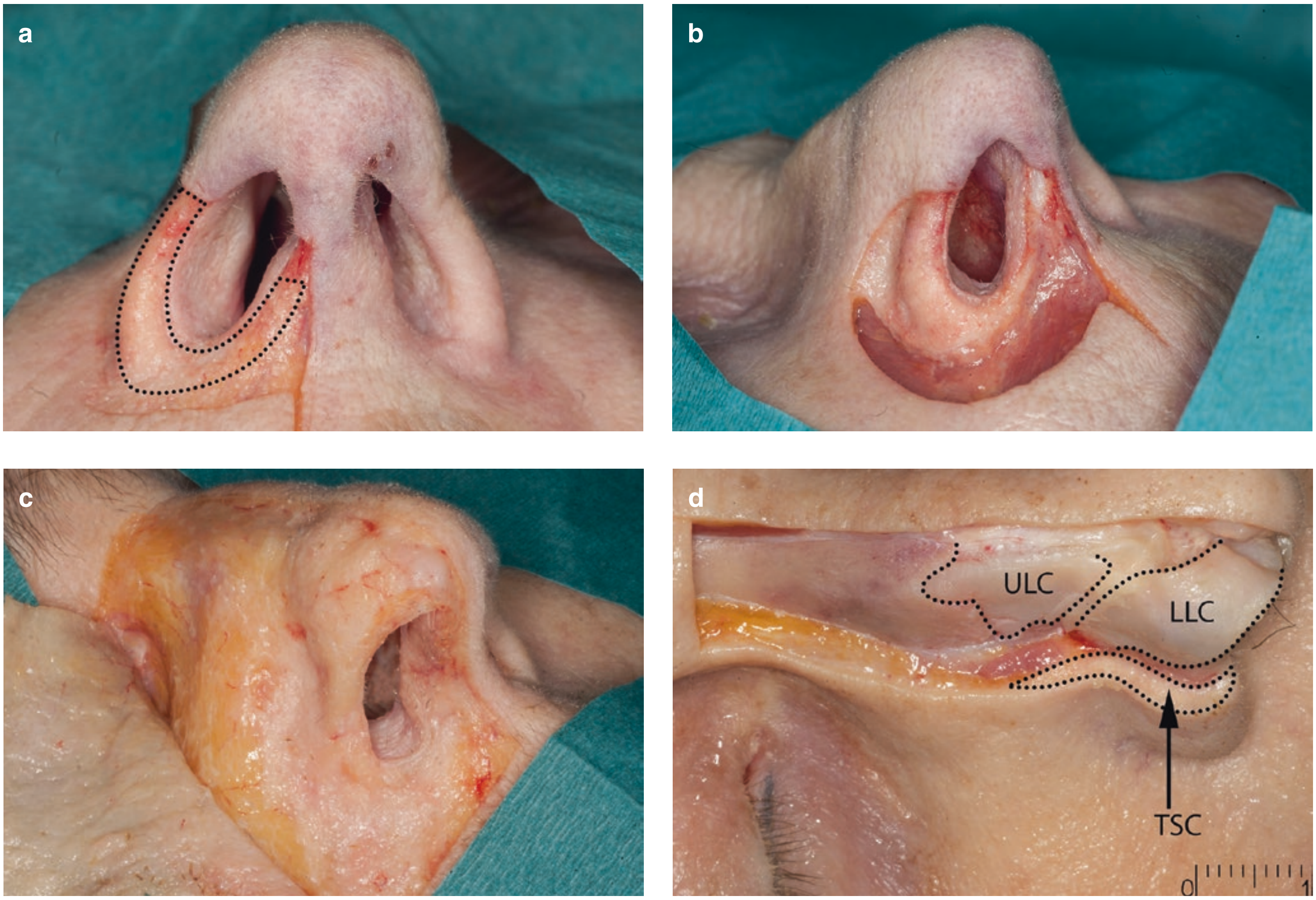


Fig. 5.28 (**a**, **b**) The tela subcutanea cutis (TSC) maintains the shape of the alar lobule, as well as its own intrinsic shape. (**c**) Extension of the TSC. (**d**) Cross-section of the STE reveals the thickness and extent of the STE in the alar region. *LLC* lower lateral cartilage, *ULC* upper lateral cartilage

The lower portion of the nasal base, extending laterally from the posterior border of the lateral crus across the alar base and nostril sill to the footplate of the medial and lateral crus is composed of soft tissue and is designated as the ***tela subcutanea cutis (TSC)***, a concept mentioned in the 29th edition of *Gray's Anatomy* (Goss 1973). When one meticulously dissects the skin off the lower nasal base, it becomes obvious that the form of the alar lobule and nostril sill are maintained (Fig. 5.28). Histological analysis shows that the curl of the nostril sill and the shape of the alar lobule are due to fibrous septae running from the deep dermal surface into the underlying muscles. *The TSC is a distinct self-supporting entity with important clinical implications.* As shown in macroscopic dissections, specific muscles run to the TSC, including the myrtiformis and the levator labii superioris alaeque nasi muscle (LLSAN). Importantly, there is no cartilage component in the alar base. With the intention of supporting the alar base, virtually an unlimited number of cartilage grafts are placed in this area (lateral crural strut grafts, lateral crural extender grafts, alar rim grafts), but surgeons should remember that this is a non-anatomical site for cartilage. Most surgeons feel that there is a direct relationship between the nasal base and the pyriform aperture. In a recent study, Bailey et al. correlated 3-D facial images with CT scans in 48 young Caucasian women and found that the pyriform width was 21.9 mm and the interalar crease distance (AC–AC) was 31.3 mm, for a difference of 9.4 mm. Anthropometrically, Hoffman et al. (1991) found the distances in a black patient to be 26.7 mm at the pyriform and 43.5 mm at AC–AC, for a difference of 16.8 mm.

(AREA 6) ALAR BASE

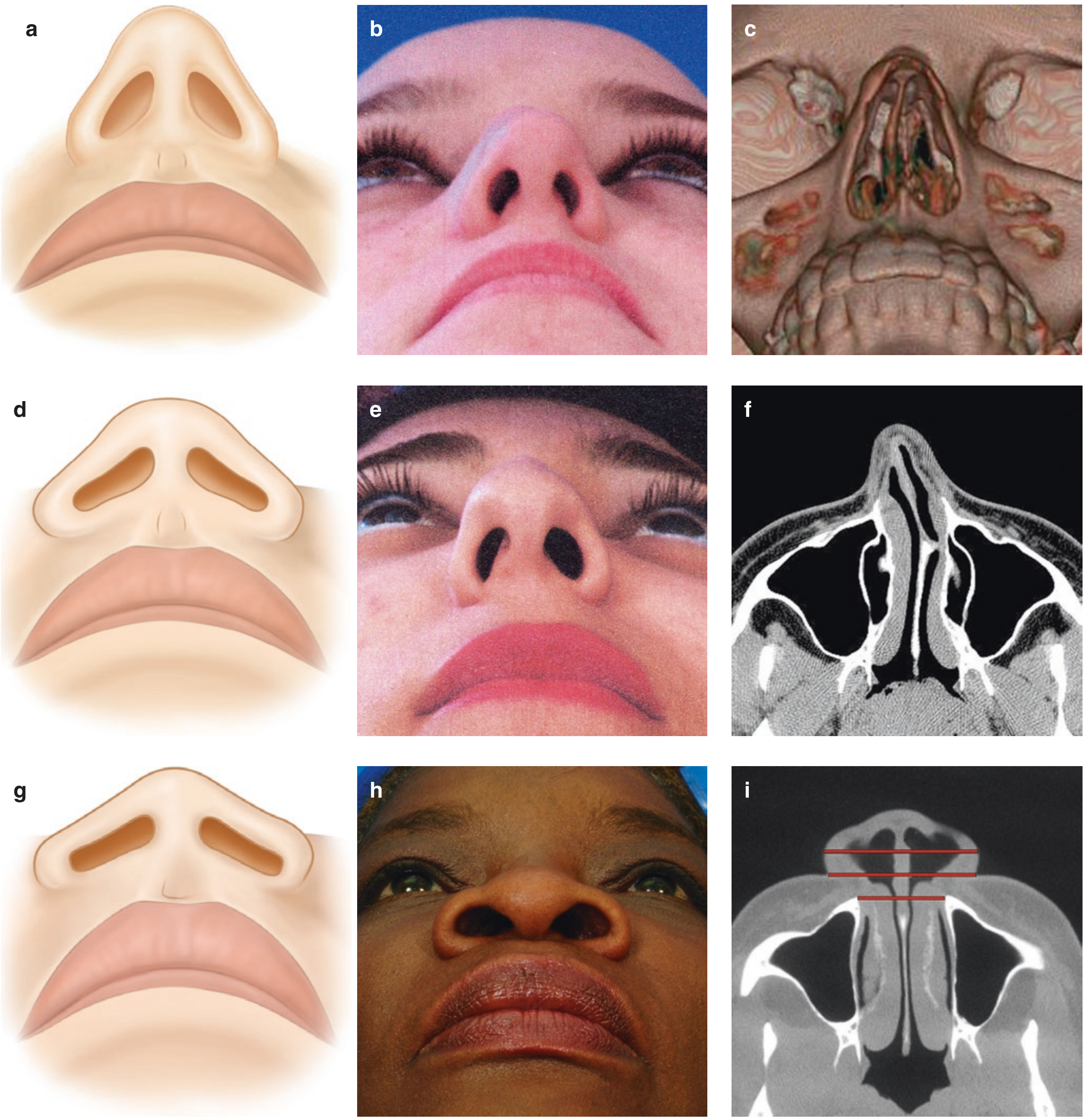


Fig 5.29 Alar base types. (**a–c**) Normal tip projection and alar base width. (**d–f**) Decreased tip projection with widening of alar base. (**g–i**) Minimal tip projection with extreme alar flare

As can be seen in Fig. 5.29h, i, the patient's measurements are 29 mm at the pyriform aperture, 45 mm at AC–AC, and 51 mm at AL–AL. Essentially, *there is no relationship between the soft tissue nasal base width and the bony pyriform aperture width*. Thus, any attempt to narrow and reduce alar width must be made at the cutaneous level rather than at the bony level. Rhinoplasty surgeons must understand the relationship between nasal tip projection and nasal base width. If the pyriform width is relatively constant, the importance of nasal projection pulling the nasal base inward and upward becomes apparent. For example, the appearance of "round nostrils" in Caucasians is a common finding following the loss of septal support; the appearance is converted to "vertical nostrils" with restoration of tip support.

(AREA 7) NOSTRIL SILL

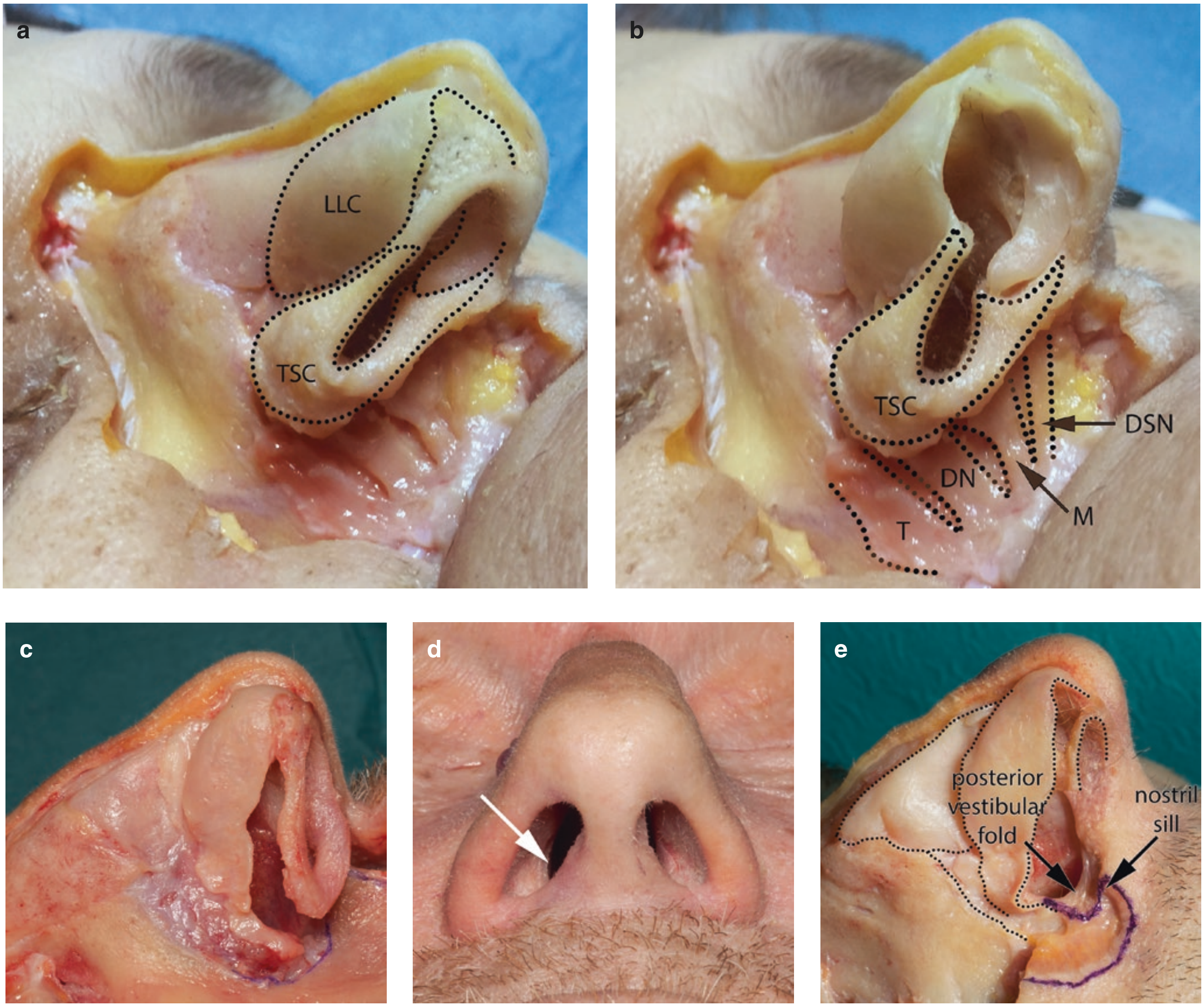


Fig. 5.30 (**a**–**c**) Nostril sill, composed of the tela subcutanea cutis (TSC) and muscle insertions, including the depressor septi nasalis (DSN), myrtiformis (M), and dilator naris (DN) muscles. (**d**, **e**) Posterior vestibular fold

The dissections in fresh cadavers shown in Fig. 5.30 reveal the true extent and composition of the nostril sill. The tela subcutanea cutis (TSC) is essentially a continuous C-shaped, folded layer of dermis and subcutaneous tissue extending from the turning point of the lateral crus around to the footplate of the medial crus. Because the TSC is continuous, the *nostril sill* is essentially a surgical aesthetic component that can be arbitrarily defined as extending medially from its junction with the columellar base to the most posterior point on the nostril axis. It has cutaneous and vestibular surfaces. Numerous muscles insert into the nostril sill, with the myrtiformis being dominant. Once the nostril sill is removed, then one sees that the floor of the vestibular aperture is concave across and also concave downward. It essentially separates the alveolar process from the nasal chamber, with the demarcation occurring at the posterior vestibular fold (Fig. 5.30e).

(AREA 7) NOSTRIL SILL

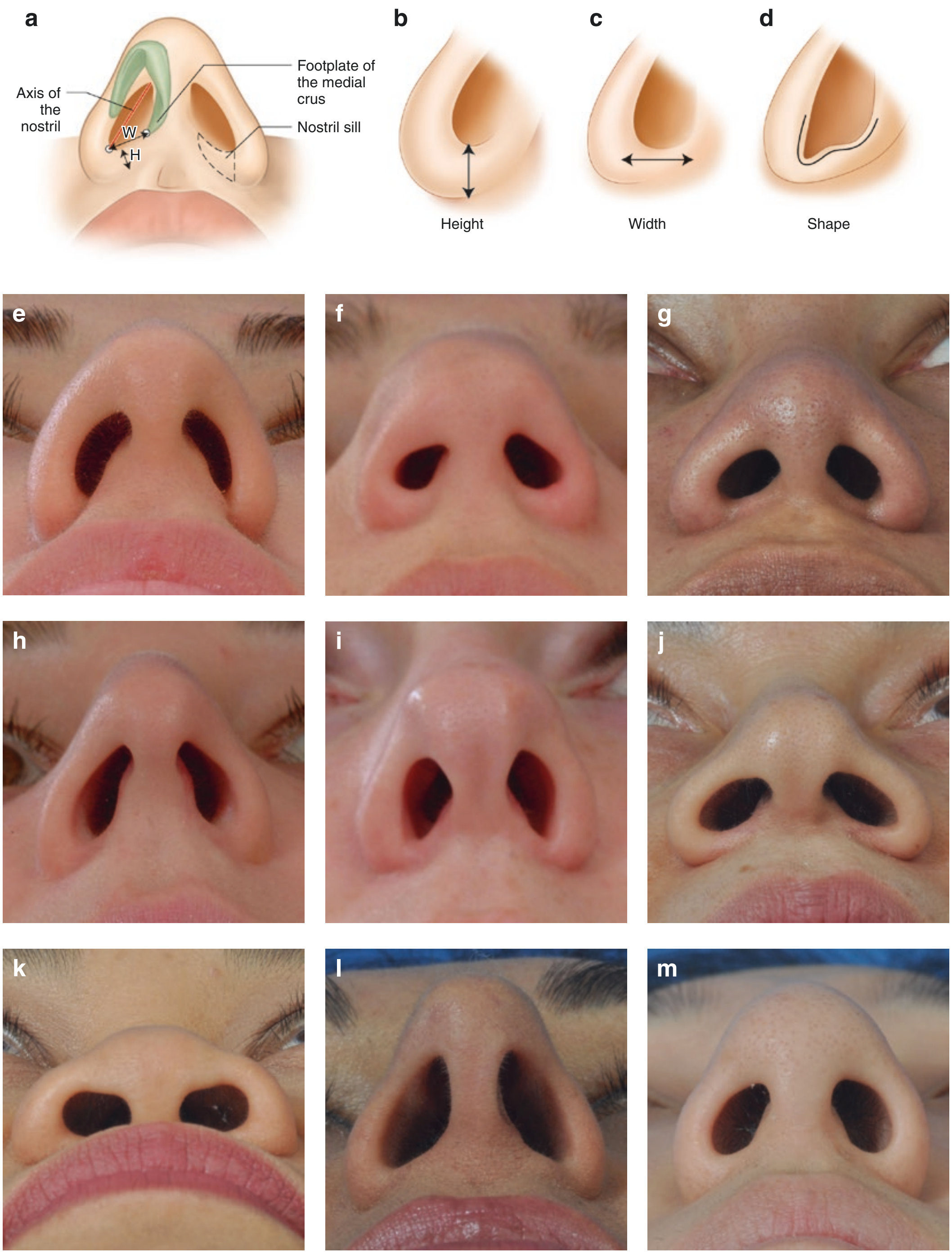


Fig. 5.31 (**a**–**m**) Nostril sill variations

The nostril sill serves as a transverse bridge from the columellar base to the alar lobule and as a longitudinal bridge from the nasal vestibule to the upper lip. The transverse shape of the nostril sill can range from broad to a narrow cleft. Its curl shape can vary widely from flat to round, approaching 8–20 mm in height from the alar crease to the nostril aperture (Fig. 5.31). Histology of the nostril sill demonstrates fibrous septae running outward like spokes of a wheel from a central core of muscle. In addition, transverse fibers arise from the labialis portion of the LLSAN.

NASAL BASE SURGICAL PROCEDURES

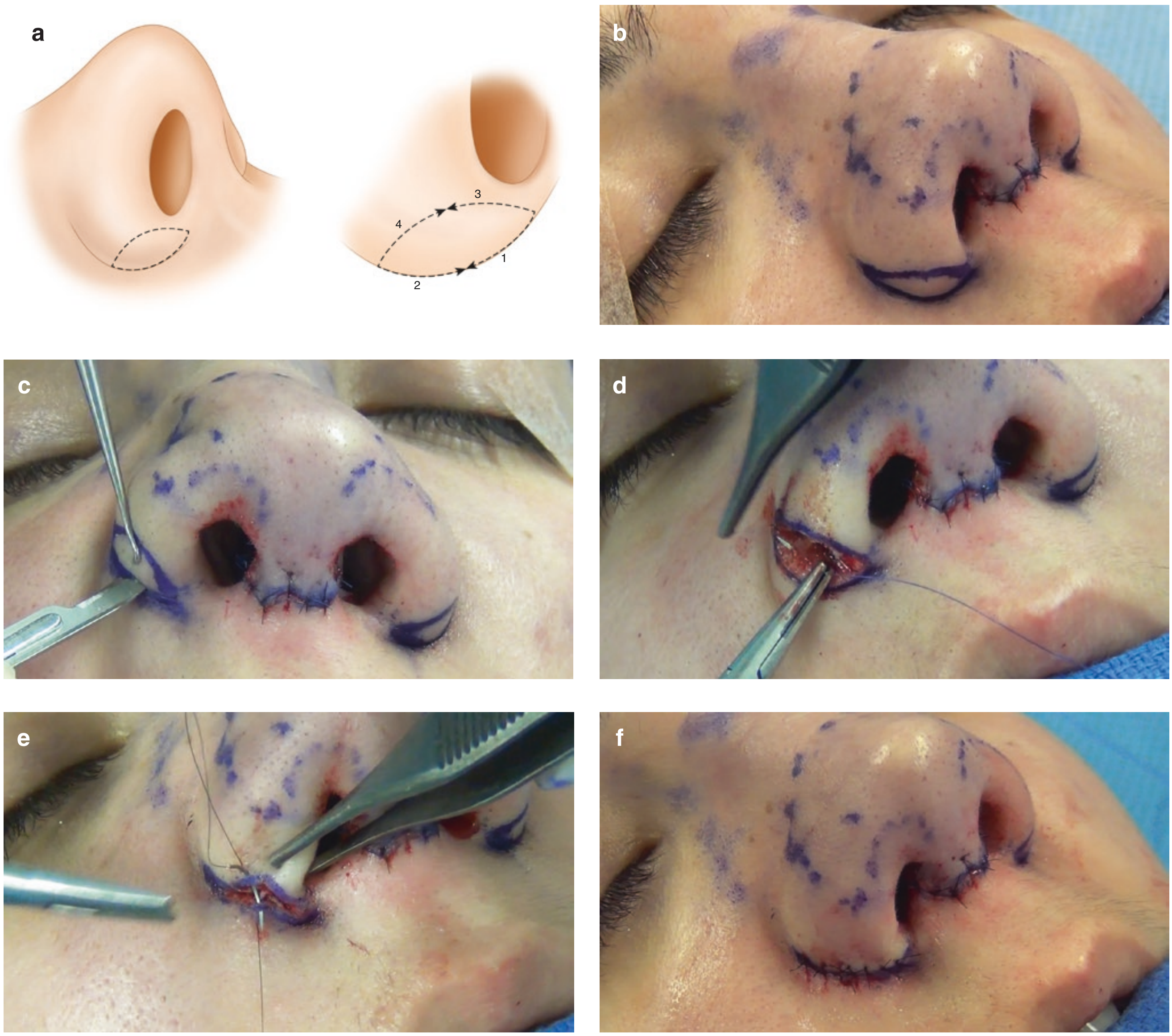


Fig. 5.32 (**a–c**) Alar wedge excision. Using a #15 blade, a V-excision is done down to the mid-muscle level, but without penetrating the underlying vestibular skin. Cauterization is necessary. The ellipse is closed in two layers: (**d**) a deep subdermal layer with 5-0 PDS and then (**e**) vertical mattress sutures of 6-0 nylon. (**f**) Additional sutures of 6-0 nylon are added as necessary

A few comments about alar base reduction in general: Although many excisional configurations exist for narrowing the alar bases, we have simplified them into three types of excisions—alar wedge, nostril sill, and combined. A few technical points: (1) The decision as to indication and type of excision is made preoperatively; (2) The alar crease is marked preoperatively and all alar incisions are made in the crease; (3) All excisions are carefully measured with a caliper prior to injection of local anesthesia; (4) About 98% of the time, similar procedures are done on each side, with only the size of the excision varied to accommodate asymmetries; (5) A fresh #15 blade is used, and all cuts are made with the area under skin-hook traction; (6) Any sill components are closed with a horizontal mattress suture of 4-0 plain catgut to ensure eversion and thus avoid a depressed scar (Q sign); (7) The skin is closed with interrupted 6-0 nylon; and (8) The sutures are kept clean until removal at 1 week. The patient cleans the suture line twice a day with hydrogen peroxide and then applies antibiotic ointment.

ALAR WEDGE RESECTION

Fig. 5.33 (**a–d**) Patient before (*left*) and after (*right*) alar wedge excision

The alar wedge (Weir) excision is an elliptical excision with an inferior border located in the alar crease and a width of 2–5 mm (which may approach 6–8 mm for certain black patients). The alar wedge is designed to reduce alar flare. Figure 5.32 illustrates the technique. With rare exceptions, we have not found the scars to be a problem and disagree with those who limit alar base modification because of scar considerations (Fig. 5.33).

NOSTRIL SILL EXCISION

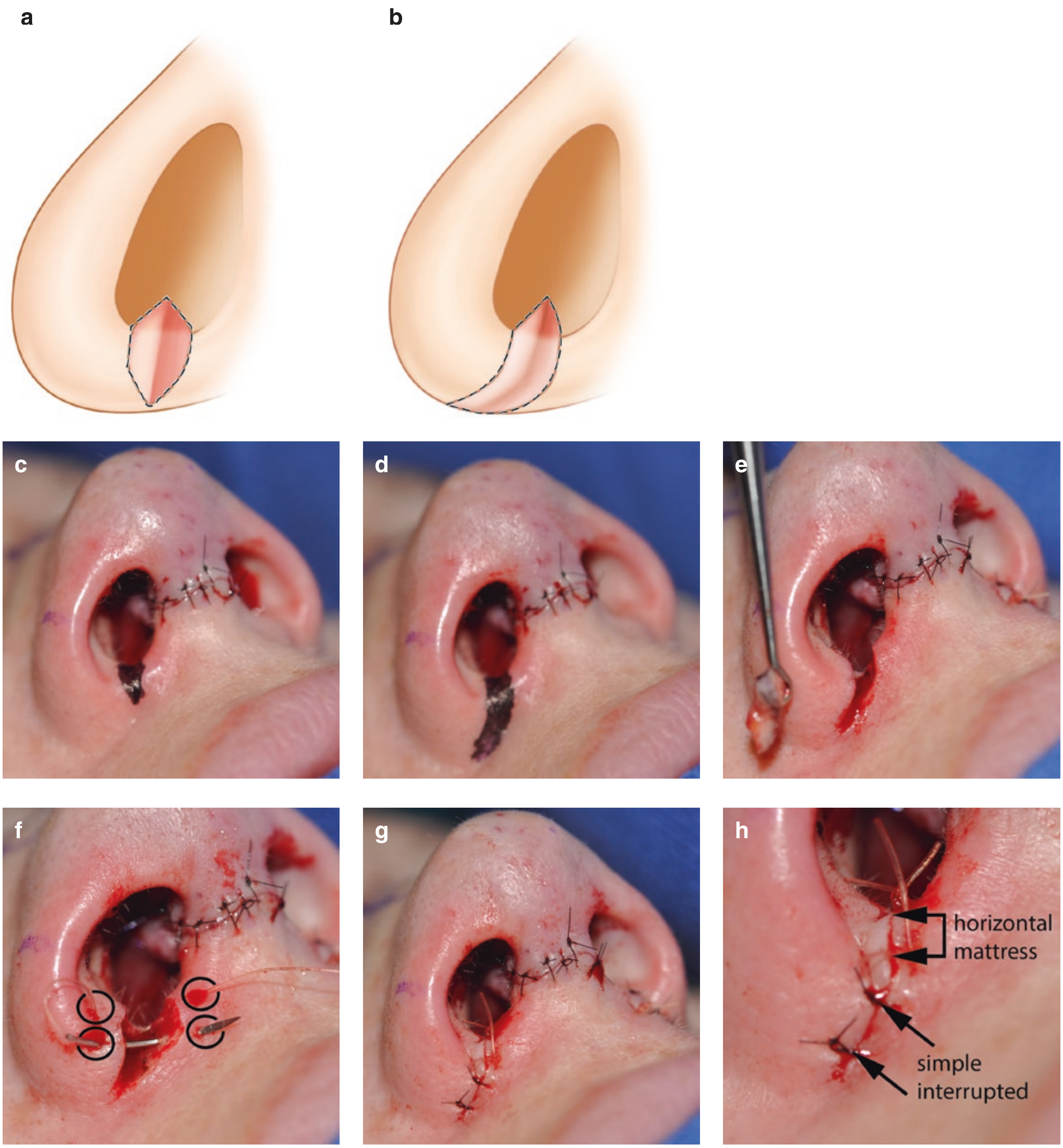


Fig. 5.34 (**a**, **c**) Standard nostril sill excision. (**b**, **d–h**) Extended nostril sill excision

The ***standard nostril sill excision*** is designed to reduce "nostril show" on anterior or oblique view. The wedge is centered in the floor vertically and is not angulated laterally (Figs. 5.34 and 5.35). It is essentially a vertical, trapezoidal wedge excision measuring 2–4 mm in width at the nostril sill, with vertical side walls 2–4 mm in height, which taper downward. In contrast, the ***extended nostril sill excision*** enters the alar crease and curves outward for a variable distance. Closure is begun with a horizontal mattress suture of 4-0 plain catgut in the vestibule, followed by one or two 6-0 nylon sutures. The goal is a smooth scar, not a depressed scar that distorts the floor of the nostril (Q sign).

NOSTRIL SILL EXCISION

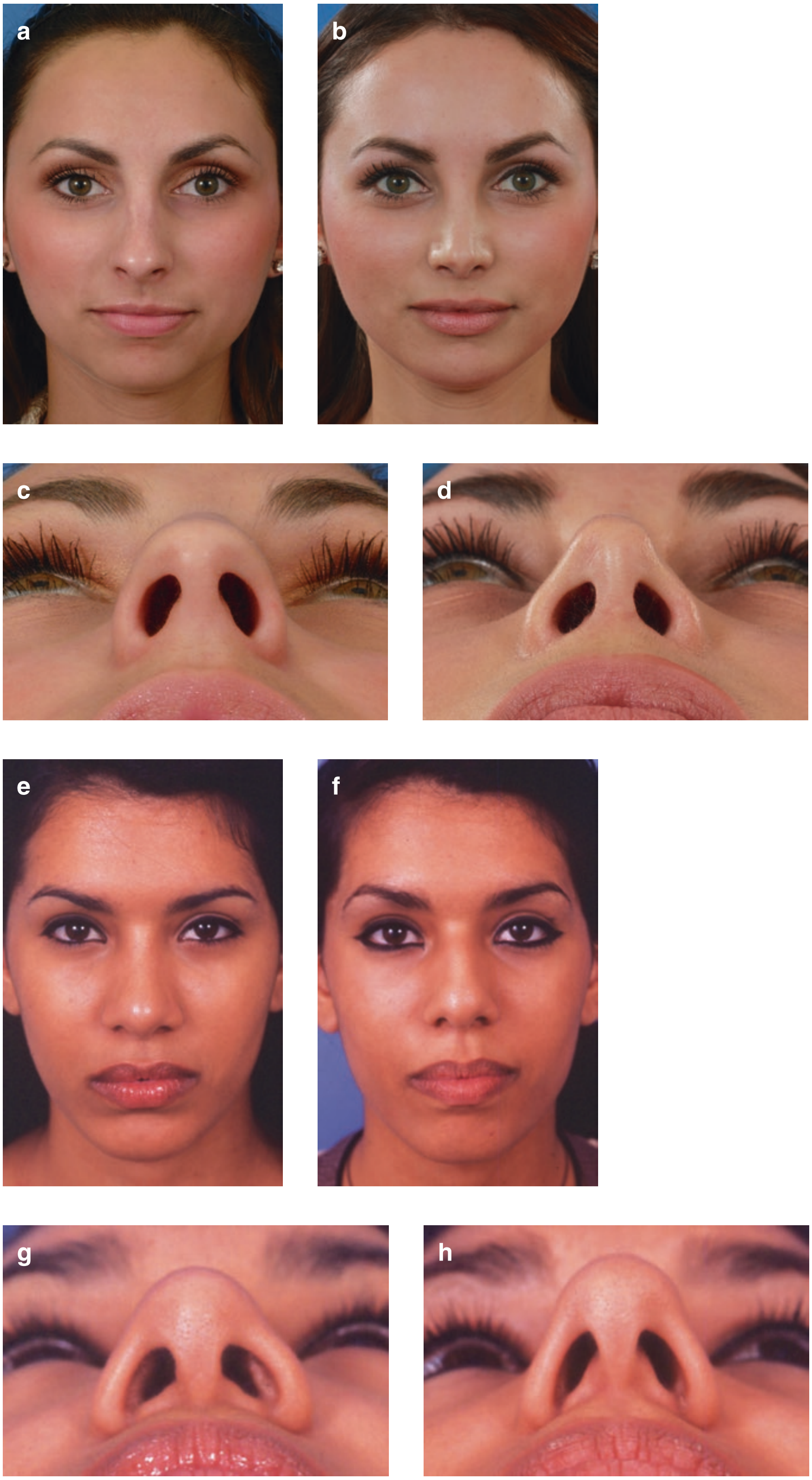


Fig. 5.35 (**a–d**) Patient before (*left*) and after (*right*) standard nostril sill excision. (**e–h**) Patient before (*left*) and after (*right*) extended nostril sill excision

COMBINED ALAR BASE AND NOSTRIL SILL EXCISION

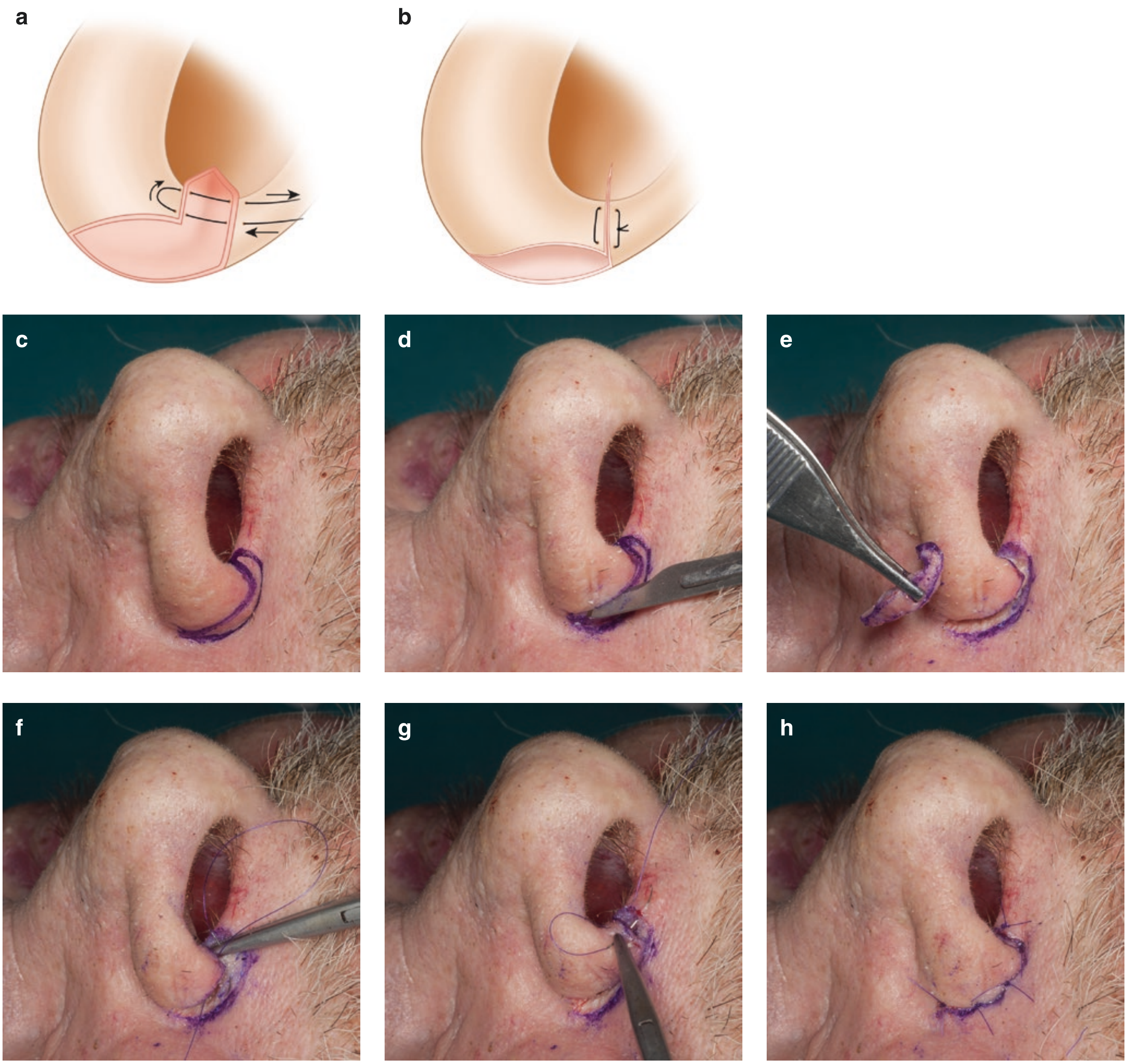


Fig. 5.36 (**a–h**) Combined alar base and nostril sill excision

A **combined alar base and nostril sill excision** is designed to narrow the alar base maximally while reducing flare at the same time (Figs. 5.36 and 5.37). Essentially, one draws the lower portion of the alar wedge excision around to the medial vertical wall of the nostril sill excision. Then using the calipers, one determines the sill width component and then the height of the alar wedge component. Under skin-hook traction, the vertical sills are cut first, then the lower alar incision, and last the superior wedge incision. Following cauterization, the sill is closed first with 4-0 plain catgut and then the rest is closed with 6-0 nylon. (NOTE: Throughout the text, we will denote the sill component first and alar component second, so a 3/4 excision is 3 mm of sill and 4 mm of alar wedge.)

COMBINED ALAR BASE AND NOSTRIL SILL EXCISION

Fig. 5.37 (**a–f**) A combined alar base and nostril sill excision, with results shown at 1 year

ALAR CINCH

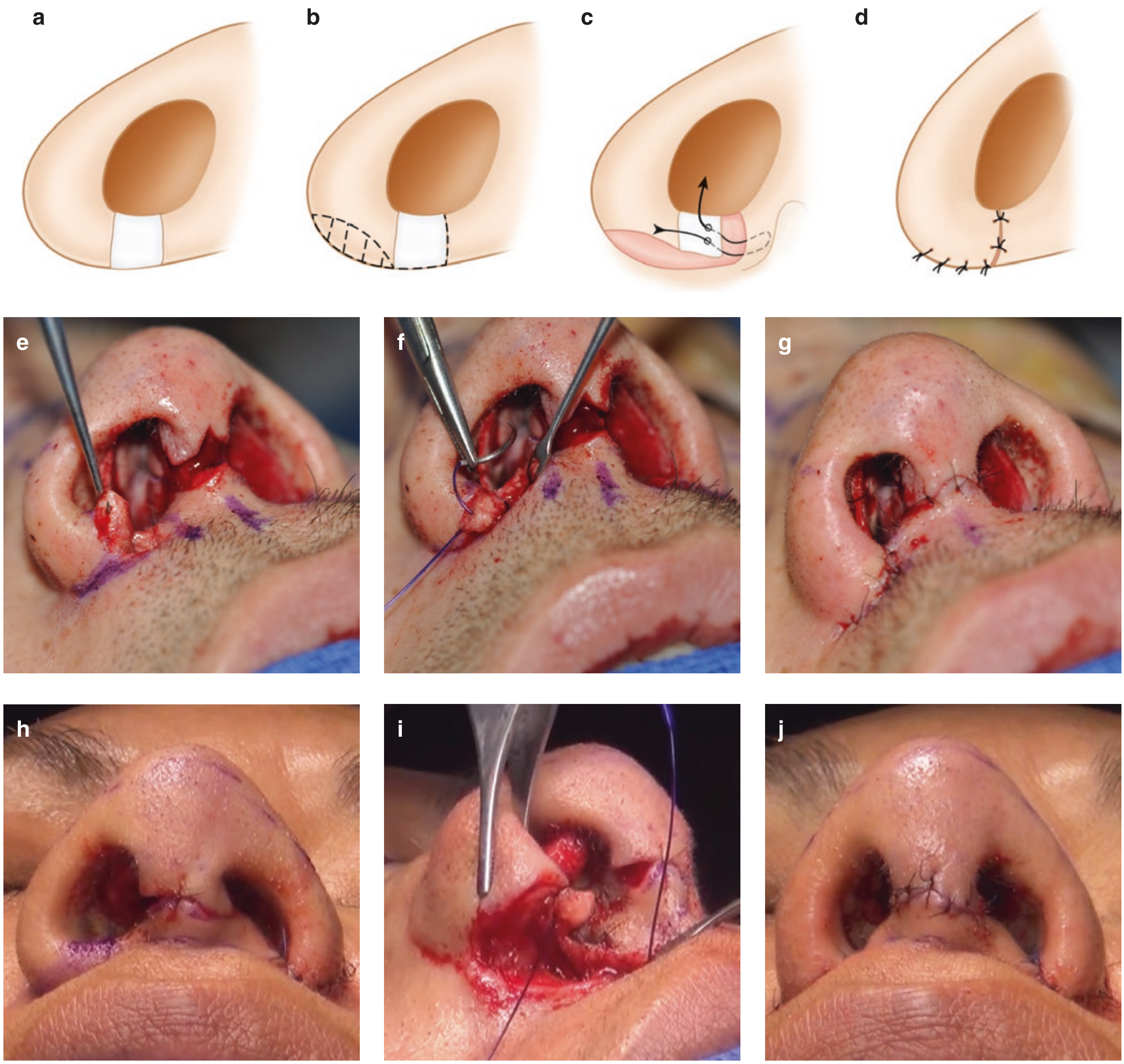


Fig. 5.38 (**a**–**d**) Alar cinch procedure. (**e**–**g**) Standard sill-only cinch. (**h**–**j**) Extended sill cinch with alar base excision

The **alar cinch procedure** was developed by Millard (1980) as a means of narrowing the alar base and plumping out the columellar base in patients with bilateral cleft lip. Essentially, the nostril sill was deepithelialized and then a suture was placed from one side to the other and cinched centrally. In aesthetic cases, the problem was that the inherent asymmetry in the two sides precluded combined traction. Therefore, we restrict the cinch to each individual side. The steps (Fig. 5.38) are as follows: (1) A 4 × 4-mm segment of nostril is deepithelialized; (2) A back-cut along the alar crease is done as necessary; (3) The deepithelialized sill is sutured to the ANS medially, using a 2-0 PDS suture on a short, round needle; and (4) Closure is done with a combination of vertical and mattress sutures of 6-0 nylon. In the extended alar cinch, one adds an alar base excision to the procedure, being careful to maintain the connection of the nostril segment to the lateral border of the alar base (Fig. 5.39).

ALAR CINCH

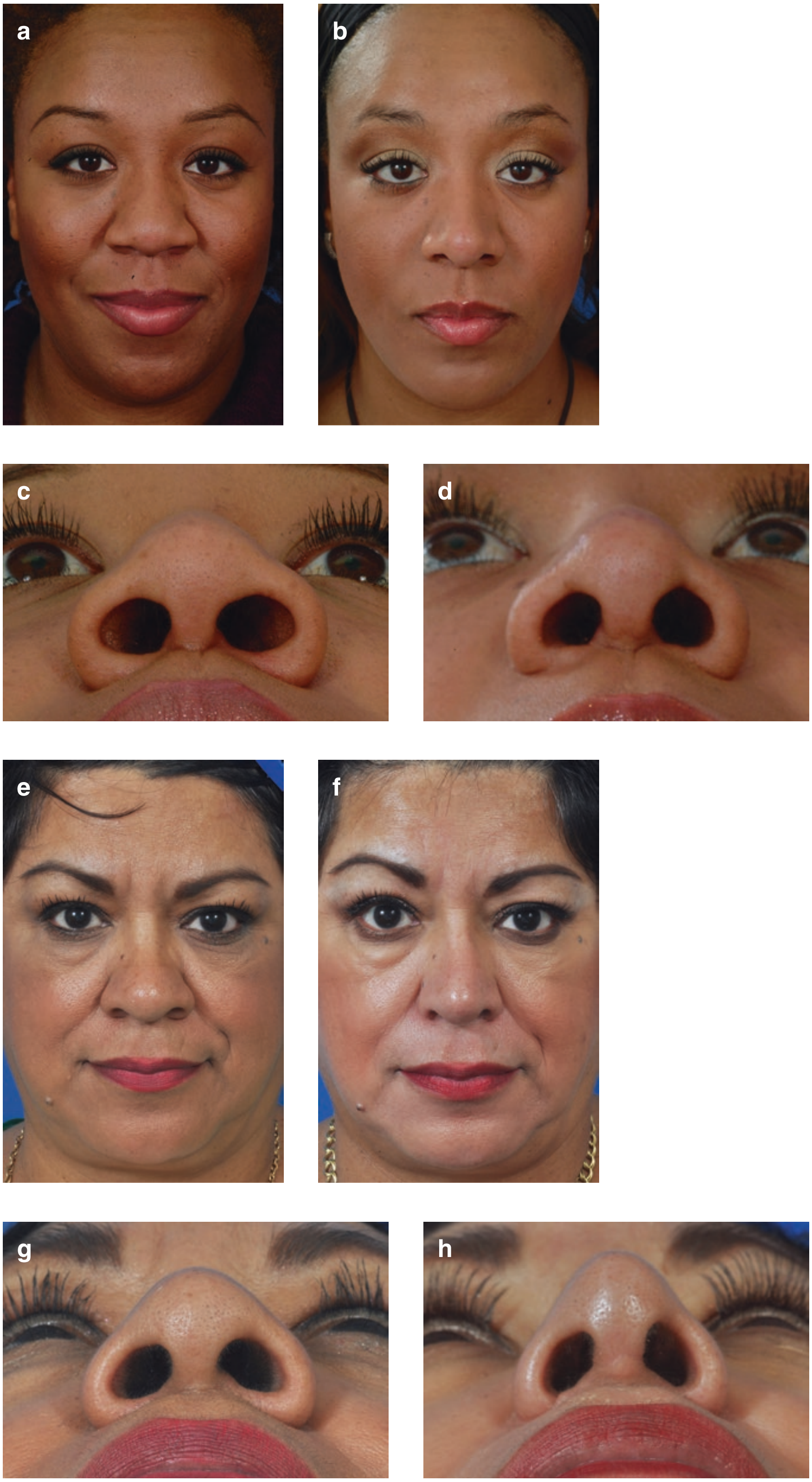


Fig. 5.39 Patients before and after alar cinch procedures. (**a–d**) Standard alar cinch without alar base excision. (**e–h**) Extended alar cinch combined with alar base excision. The combined procedure reduces width and "roundness" of the nostrils

NOSTRIL NUANCES (AREA 8)

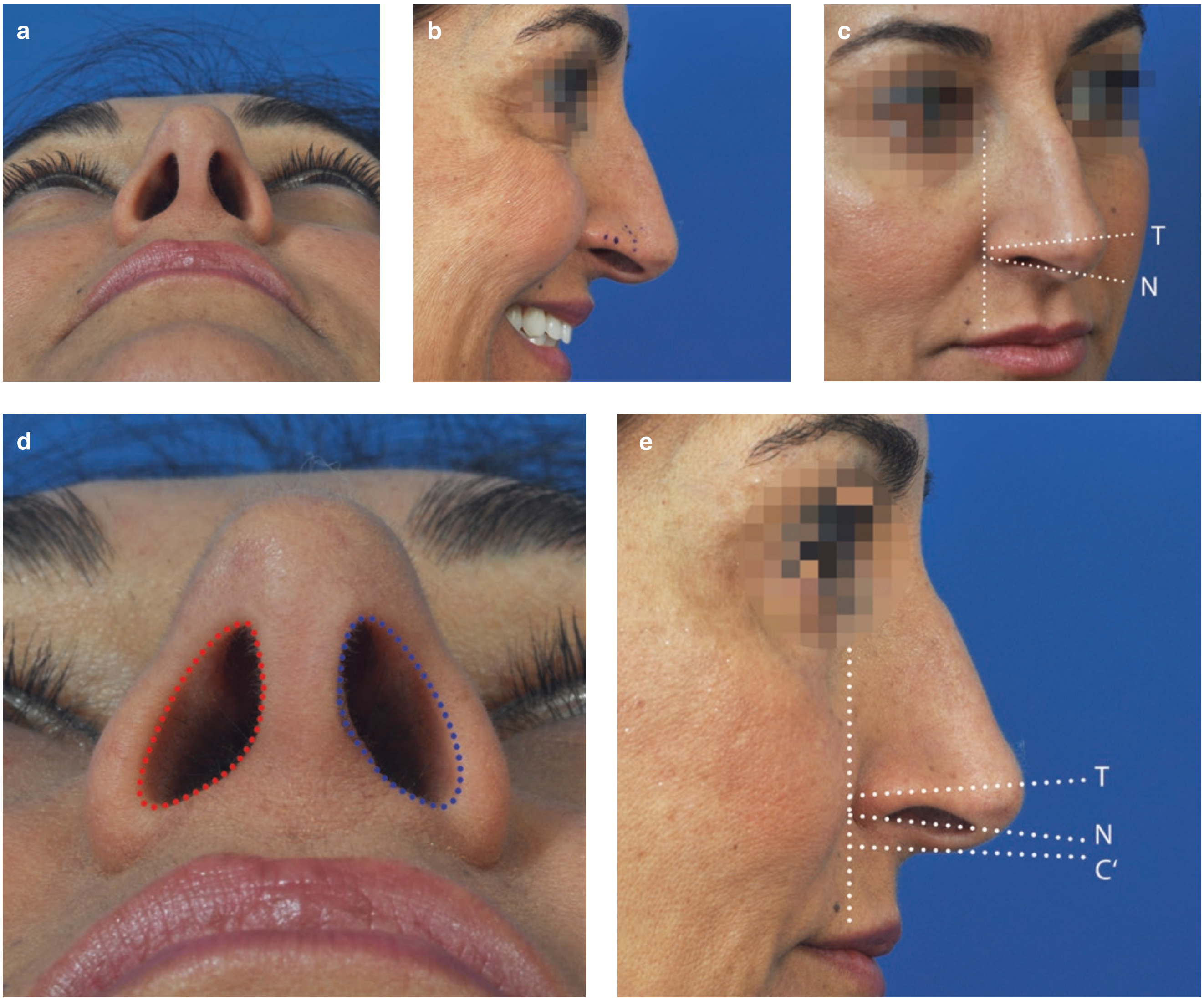


Fig. 5.40 (**a–e**) Nostril nuances

Only after reading about and understanding the seven areas of the nose can one appreciate the nostril nuances. Now that the left brain has absorbed the descriptive text, one can now use the right brain to appreciate the spacial components of the nostril. In simpler terms, one can now see the doughnut hole rather than the doughnut. On basilar view, outlining each nostril shows significant differences in overall size and inclination, but on close inspection one begins to note differences in the slope of the columellar base, which in turn affects the width of the nostril sill. The nostril apices are also different. The patient shown in Fig. 5.40, for instance, was told that her left nostril was her "round jelly bean" and the right nostril was her "pointy almond." Patients tend to remember these descriptive terms postoperatively and are less concerned with persistent nostril asymmetry. On oblique view, one sees the dramatic difference in the ideal tip angle vs. the downward angle of the nostril. In addition, the nostril rim breakpoint is significantly posterior, which accentuates the overall droopiness of the nose. On lateral view, it is obvious that the nose has a "droopiness" to it which is accentuated by the downward slant of the nostril angles (80°) *vs.* the columellar inclination (90°) and tip angle (98°) (Fig. 5.40d). On further analysis, the alar rim breakpoint is posterior to the alar groove (Fig. 5.40e), and the rim ratios have reversed to 1/3:2/3 from the normal of 2/3:1/3. On smiling view, the alar rim breakpoint moves even further posterior, with straightening of the alar rim.

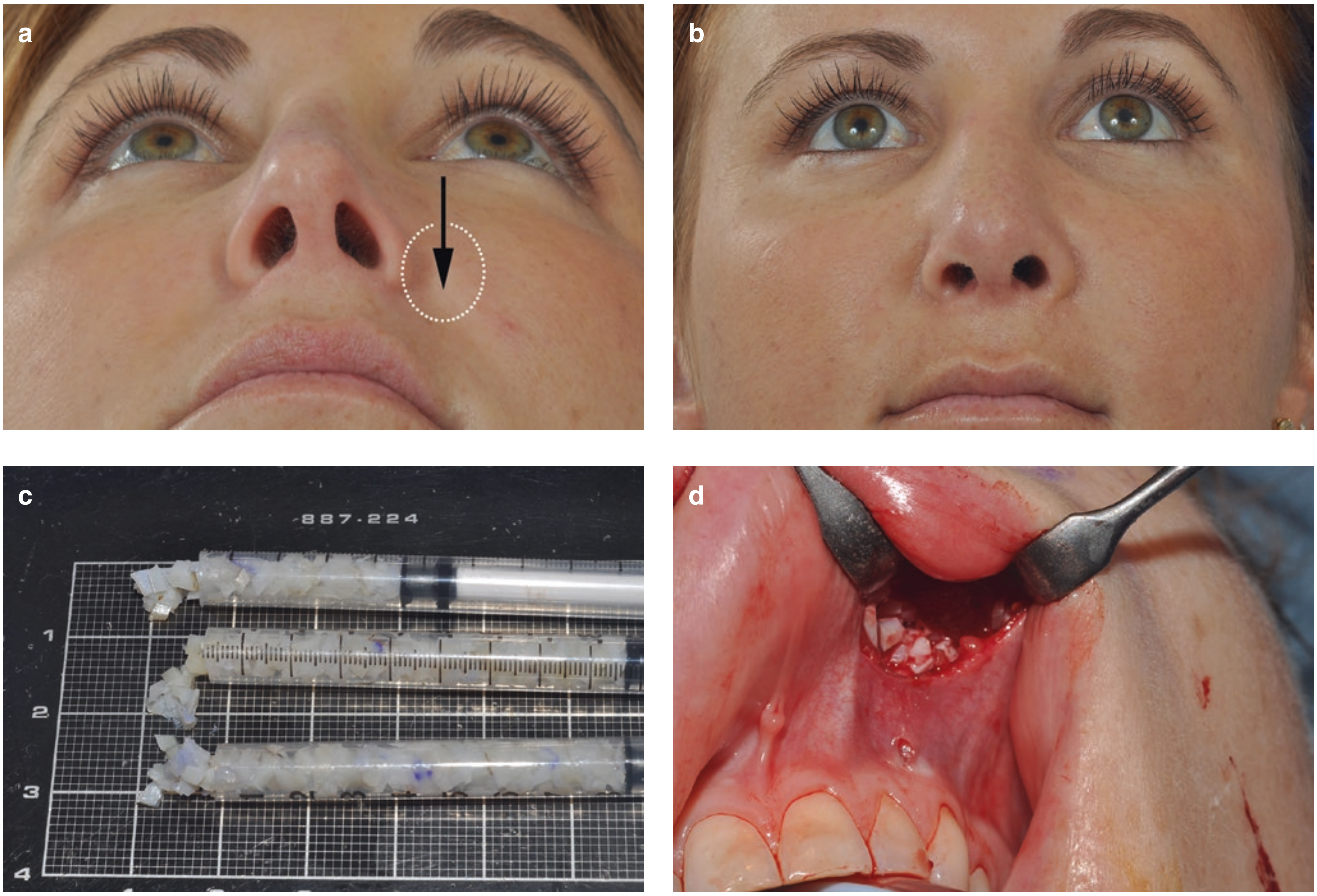


Fig. 5.41 (**a–d**) Nasal base support provided by a diced cartilage (DC) graft to the maxilla

Sheen (1978) frequently grafted the premaxilla and pyriform area using Supramid mesh. Instead of using foreign bodies, we have found that coarsely chopped diced cartilage (DC) provides greater flexibility and less risk of infection, and can be easily removed if necessary. Figure 5.41 shows a secondary rhinoplasty patient with significant facial asymmetry, in whom augmentation of the left pyriform area provides essential support to the entire parapyriform area along the frontal process of the maxilla. Rib cartilage is diced to 1-mm pieces (significantly larger than for dorsal augmentation), and then a gingival incision is made for access. A subperiosteal dissection is done, and a relatively tight pocket is made. The DC is simply placed into the area with a 25% overgrafting and the incision is closed with 4-0 chromic catgut. We have not found it necessary to use a shaped DC-F graft as others have recommended. Clinically, we view this as a minor, moderate, or major approach. In minor cases, the DC is injected through a vestibular incision, which is either superficial (just under the alar base) or deep (subperiosteal tunnel). For moderate cases, we inject 1–2 cc in a subperiosteal pocket using the gingival approach. Alternatively, one can use solid blocks of cartilage for major cases involving heavily scarred areas, as in patients with cleft lip. We place solid blocks of cartilage (6–10 mm thick) beneath the alar base via a gingival approach. As demonstrated in the following case study, the entire gingival area can be grafted, especially in cocaine noses.

RECONSTRUCTION OF NOSTRILS AND PYRIFORM PLATFORM (CASE STUDY)

Analysis: A 37-year-old woman presented with a long history of cocaine addiction and multiple surgical attempts to reconstruct the nose. Previous operations had included nasolabial flaps and rib grafts. The most recent operation was 7 years previously. The patient was “clean” due to an incarceration. Stenosis of the nostril aperture was the greatest challenge. Total perforation of the septum was also present.

Operative Technique: This collapsed nose needed to be relined and supported, with a strong structural form created to resist the forces of contracture (Fig. 5.42).

1. Harvest of fascia, costal cartilage (eighth and ninth ribs), and full composite grafts from both conchal bowls.
2. Extension of the columella using “forked flaps” from the long upper lip for V-Y lengthening.
3. Composite reconstruction. Spreader grafts and septal strut for foundation layer.
4. Columellar strut and structural tip graft with perichondrial padding for aesthetic layer.
5. Lateral wall stabilization with thin rib grafts (20 × 15 mm).
6. “Wrap around” conchal bowl composite graft (25 × 9 mm) to vestibular/nostril defect.
7. Dorsal augmentation with DC-F graft (0.8 cc). DC (1.0 cc) to each parapyriform aperture area.

Commentary: Total release over the entire parapyriform area was necessary, followed by insertion of large amounts of diced cartilage into the parapyriform pockets to replace the soft tissue volume. The most innovative part of the reconstruction was to advance flaps from along the nasal-lip junction, which allowed lengthening of the columella, with the addition of skin to the medial nostril and shortening of the long upper lip. The conchal composite grafts replaced approximately 80% of the entire nostril and allowed patency of the nasal airway to be maintained at 1 year postop (Fig. 5.43).

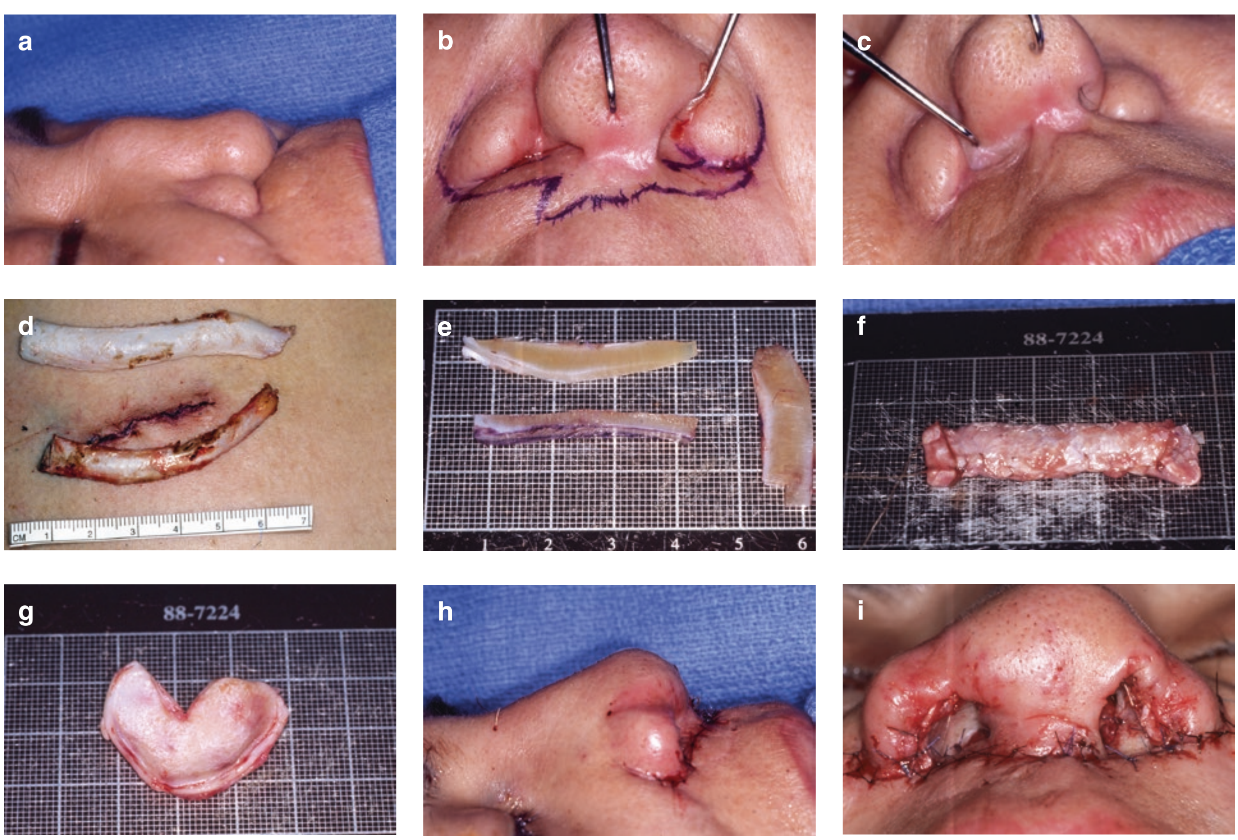


Fig. 5.42 (**a–i**) Nostril reconstruction

RECONSTRUCTION OF NOSTRILS AND PYRIFORM PLATFORM (CASE STUDY)

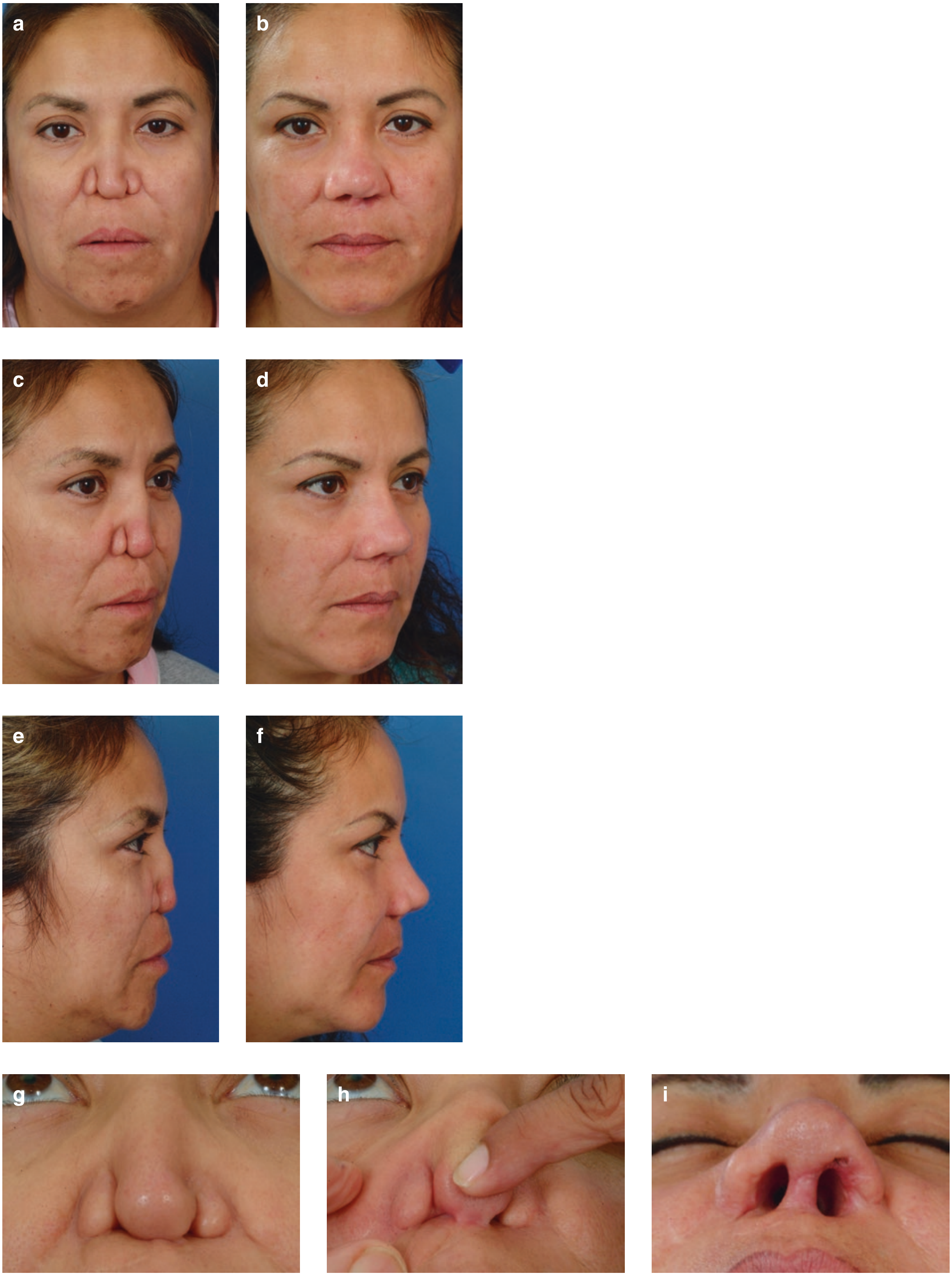


Fig. 5.43 (**a–i**) Patient before and 1 year after nostril reconstruction

READING LIST

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6

Grafts

After inserting several thousand grafts during rhinoplasty surgery, we have reached ten conclusions:

1. Grafts must be an integral part of analysis and preoperative planning, not an intraoperative necessity. For example, the decision to do a tip graft or a radix graft will influence the amount of dorsal reduction.
2. One must be adept at using all types of donor material and not depend on just one type. Although septum is usually sufficient in primary cases, it is often insufficient in complex secondaries, making rib grafts essential.
3. One should be able to harvest a graft quickly. If it is difficult to take a graft, then one will often rationalize why it is not needed.
4. Graft shaping and recipient bed preparation are of equal importance.
5. The less done to a graft the better. We are dubious of the long-term survival of crushed and even bruised cartilage grafts.
6. Fixation of the graft most often requires suturing.
7. Antibiotic coverage is important, including an intravenous dose during the operation and for 5 days postoperatively.
8. Alloplasts may be a shortcut for the surgeon, but they increase the risk of failure for the patient.
9. Autogenous grafts rarely extrude, can withstand infection, and definitely have stood the test of time.
10. Grafts have dramatically improved the quality of our rhinoplasty results, allowing for a more natural, functional primary result and a heretofore unobtainable nonoperative look in secondary cases.

SEPTAL GRAFT HARVEST

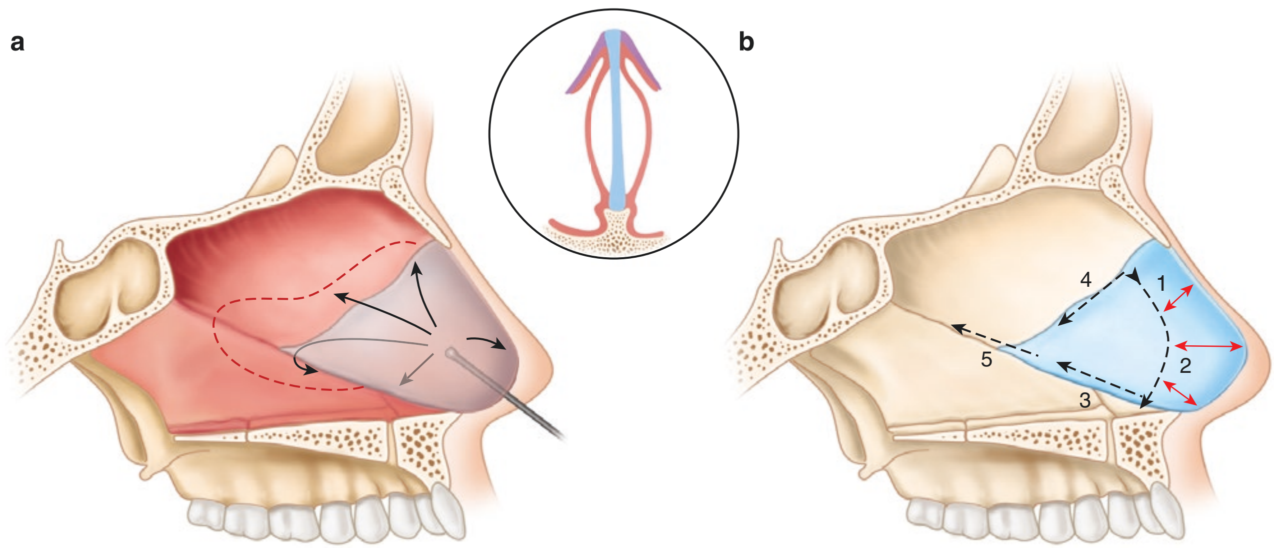


Fig. 6.1 (**a**, **b**) Septal harvest

Septal cartilage is the graft material of choice because of its survival, strength, shaping, and availability. Technically, harvesting cartilage from a "normal" septum is far easier than doing a septoplasty on an "abnormal" deviated septum or reentering the septum during a secondary case. Before harvesting septal cartilage, the septum is reinjected with local anesthesia (1% xylocaine with epinephrine 1:100,000) to produce hydro dissection. In general, the amount of cartilage to be resected is determined by the types of grafts required, while preserving at least a 10-mm L-shape strut dorsally and caudally. For decades, surgeons made a right-angle dorsal cut, which is structurally unstable and prone to breakage. It is far better to make a soft, round cut and preserve 15 mm on a diagonal. Before the actual harvest, three things must be done: (1) The definitive dorsum and caudal septum must be established; (2) The mucosa must be elevated bilaterally back to the bony septum; and (3) The side with the septal spur must be identified, indicating the side with the septal extension (Fig. 6.3a). The following five-step septal harvest is then performed (Figs. 6.1 and 6.2):

1. Dorsal incision 10 mm below and parallel to the estimated new dorsal septum
2. Caudal incision 10 mm back and parallel to the caudal septum
3. Posterior dissection with mobilization of the septum out of the vomerine groove
4. A downward "push" disarticulation of the cartilaginous septum from the bony perpendicular plate
5. Careful mobilization of the cartilaginous tail of the septum, which can be 10–15 mm long

At this point, the cartilaginous septum is completely disarticulated and easily removed. Although many surgeons close the mucosal leaflets with 4-0 chromic sutures, I prefer to use silastic nasal splints, which provide compression over a greater region and prevent synechiae between the septum and the turbinates. Access incisions are closed in the standard fashion. The goal is to remove septal cartilage only. There is no need to harvest an osseocartilaginous piece of septum in most primary cases, except in ethnic patients.

SEPTAL GRAFT HARVEST

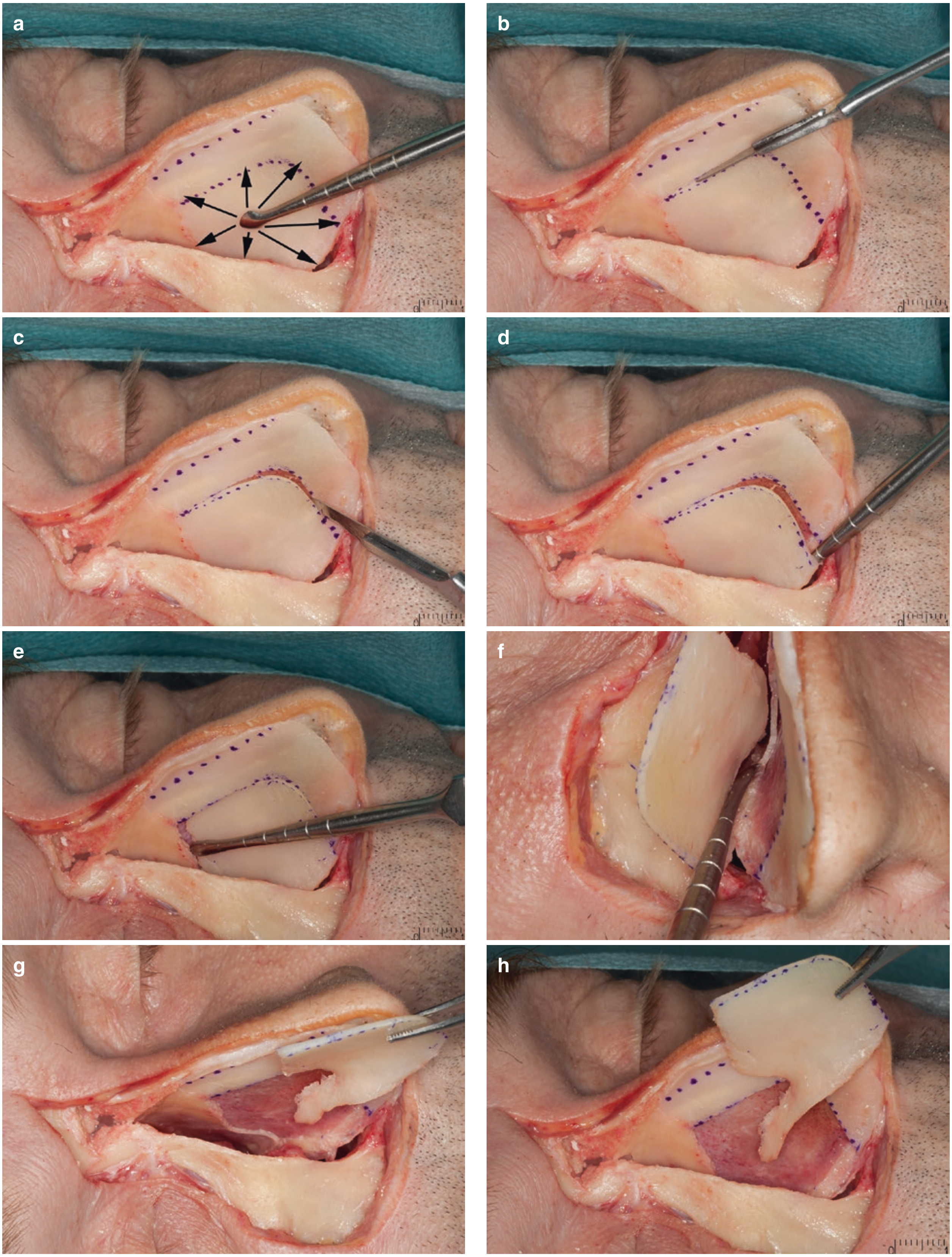


Fig. 6.2 (**a–h**) Cartilaginous septal harvest

COLUMELLAR STRUT

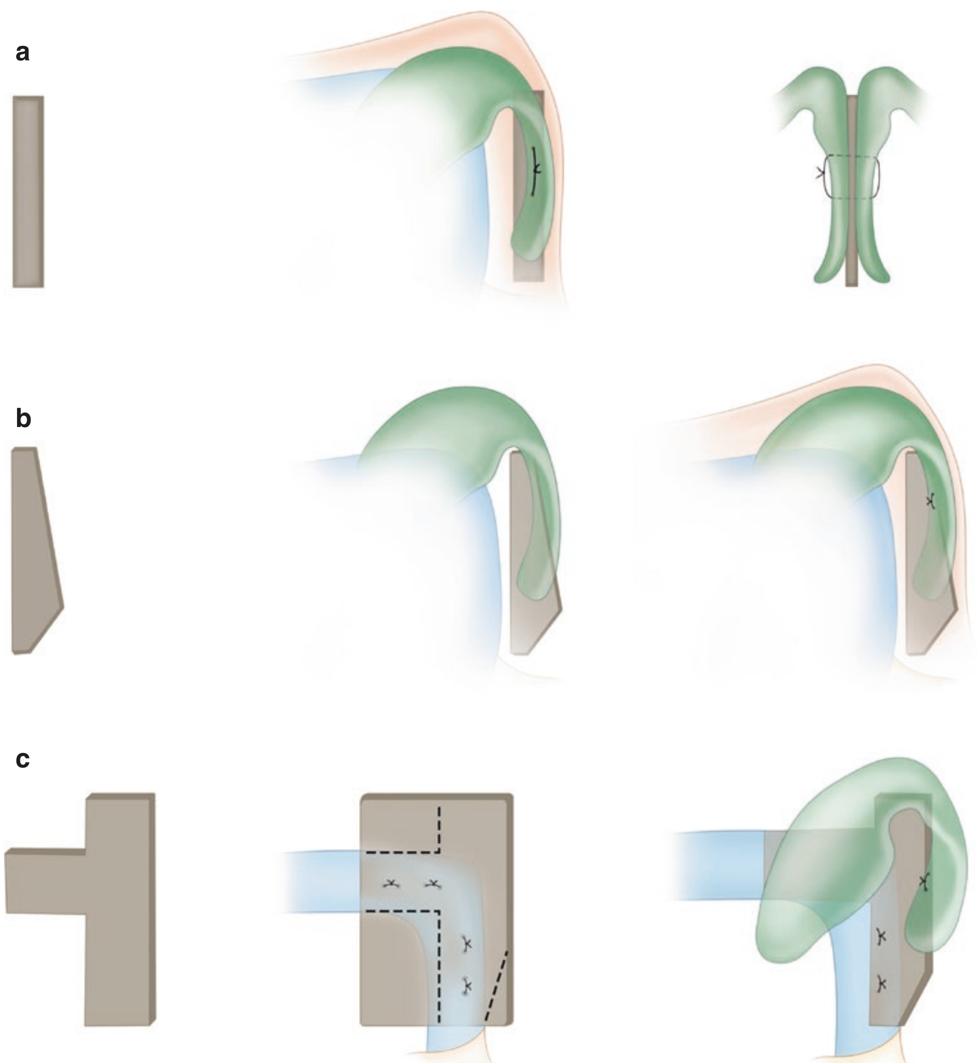


Fig. 6.3 Columellar struts. (**a**) Crural strut. (**b**) Extended columellar strut. (**c**) Septocolumellar strut

For years, surgeons have called any graft placed in the columella a columellar graft, but we prefer the term ***crural strut*** to denote the purpose of the graft, which goes in between the middle and medial crura. The crural strut provides stability and allows the surgeon to shape the tip (Figs. 6.3a and 6.4a). It does not rest on the anterior nasal spine (ANS). The usual crural strut graft measures approximately 20 mm in length and 2–3 mm in width, with the thicker portion located inferiorly. We rarely use an angled strut. The strut is placed between the medial and middle crura, with the inferior end short of the nasal spine. The crura are then advanced upward and rotated medially 90° before being fixed to the strut just below the domes, using a #25 needle. A horizontal suture of 5-0 polydioxanone suture (PDS) fixes the crura to the strut and is placed in the middle crura above the columellar breakpoint. The superior portion of the strut can be cut to fit beneath the domes, and the inferior portion can be cut off if there is too much fullness at the columella-labial angle.

Extended columellar strut grafts (Figs. 6.3b and 6.4b) tend to be longer (30 mm) and are shaped to influence the columellar inclination. They measure 8–10 mm at their widest portion, which is the junction between the upper two thirds and the lower one third of the strut. After its insertion between the crura, a distinct change should be seen in the columellar inclination of the columella-labial angle. Again, the graft is kept short of the ANS to avoid clicking. These grafts are frequently used in ethnic noses and in the older patient with an acute columella-labial angle.

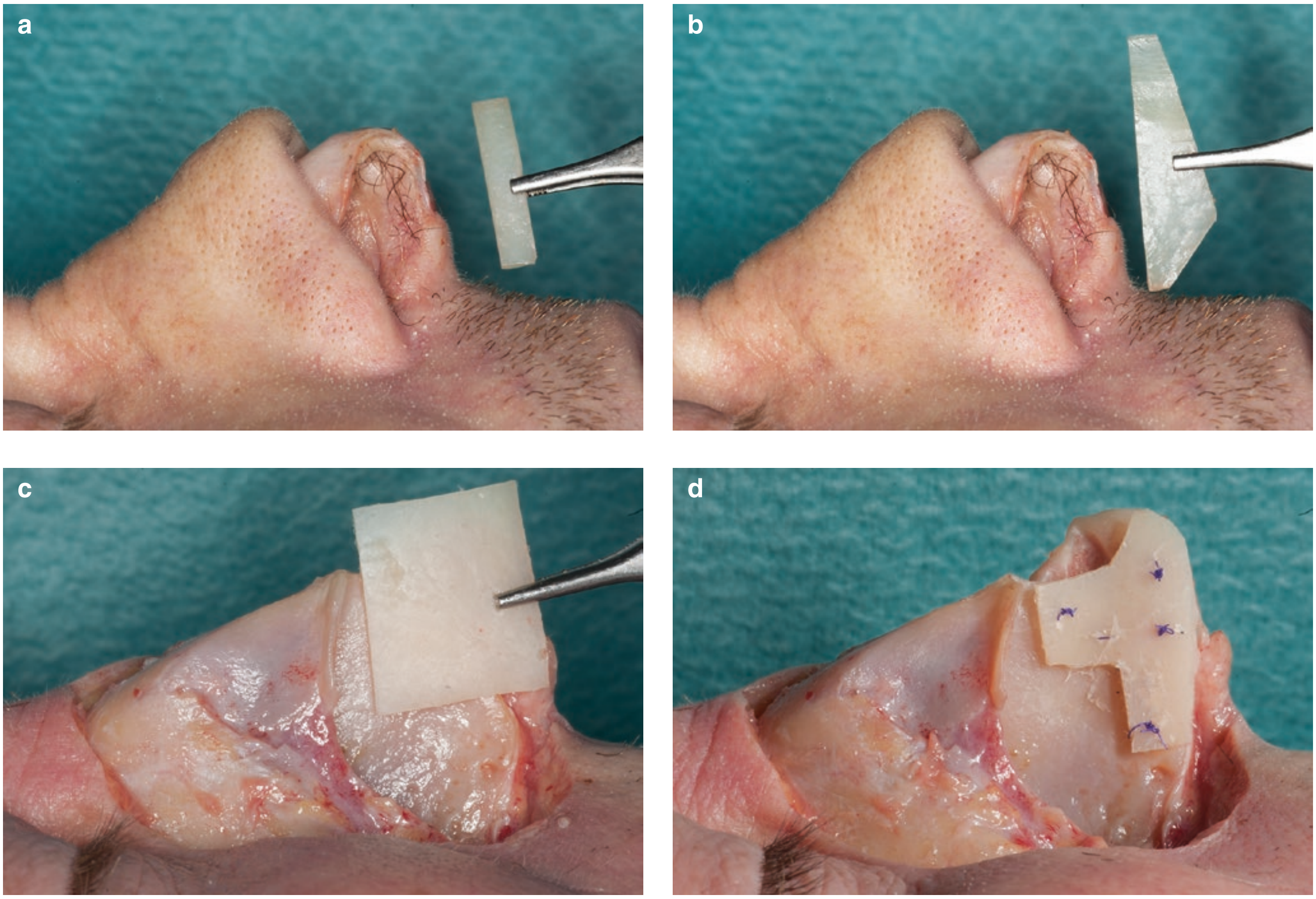


Fig. 6.4 (**a**) Crural strut graft. (**b**) Extended columellar strut graft. (**c**, **d**) Septocolumellar strut graft

Septocolumellar struts (Figs. 6.3c and 6.4c, d) are structural grafts designed to provide support to the distal third of the nose; thus, they represent a replacement or reinforcement of both the caudal septum and the columella. In general, we insert large segments of osseocartilaginous septum (30 mm high × 20 mm long) via a combined dorsal/tip split. The structure graft is fixed to the septum in an overlapping fashion at multiple points with 4-0 PDS. Then the crura are advanced upward onto the strut, fixed with a #25 needle, and sutured with 5-0 PDS. The strut is contoured cephalically to fit the supratip setoff. The most common application is in Asian noses and lengthening of the upwardly rotated tip. I called these *septocolumellar* or *"tomahawk" grafts* (Daniel 2002; Kim and Daniel 2012). Toriumi (1995) refers to them as *septal extension grafts*.

As will be discussed at length in this chapter, there is a wide variety of grafts for projecting and supporting the tip and extending the columella in both primary and secondary cases. Essentially, the surgeon must understand that there is a wide spectrum of cases ranging from primary cases that require a crural strut to stabilize the sutured tip to reconstructed noses in need of major structural grafts that include extended spreaders and septal extension grafts derived from rib cartilage.

COLUMELLAR STRUTS (CASE STUDY)

Analysis: A 24-year-old patient of Asian descent presented with two problems: nasal obstruction and a dorsal hump (both unusual in the Asian patient). On internal exam, the septum was markedly deviated and the turbinates were massive. There was no history of nasal trauma. The patient's goal was to eliminate the dorsal hump and achieve a more attractive tip. As usual, the patient agreed to a possible fascia and concha graft.

Operative Technique (Fig. 6.5):

1. Fascial harvest. Open approach at subdermal level with soft tissue excision. No alar excision.
2. Dorsal reduction (B 1.0 mm, C 4.5 mm).
3. Major septal harvest via a dorsal split, extending across the osseocartilaginous junction.
4. Intermediate osteotomy—R (midlevel).
5. Insertion of a major "tomahawk" columellar strut. Alar cartilages advanced onto the strut. Two columellar sutures.
6. Insertion of a combined radix/dorsal fascial graft.
7. Coblation and outfracture of the inferior turbinates.

Commentary: The crux of this nasal deformity was both the dorsal hump and the under-projecting tip (Fig. 6.6). The major "tomahawk" columellar strut achieved three things: (1) The columellar base was advanced upward, changing the columella-labial angle from acute to upward; (2) The columellar breakpoint (c′) was moved from below to above the nostril apex; and (3) The intrinsic tip projection (c′ to T) was increased.

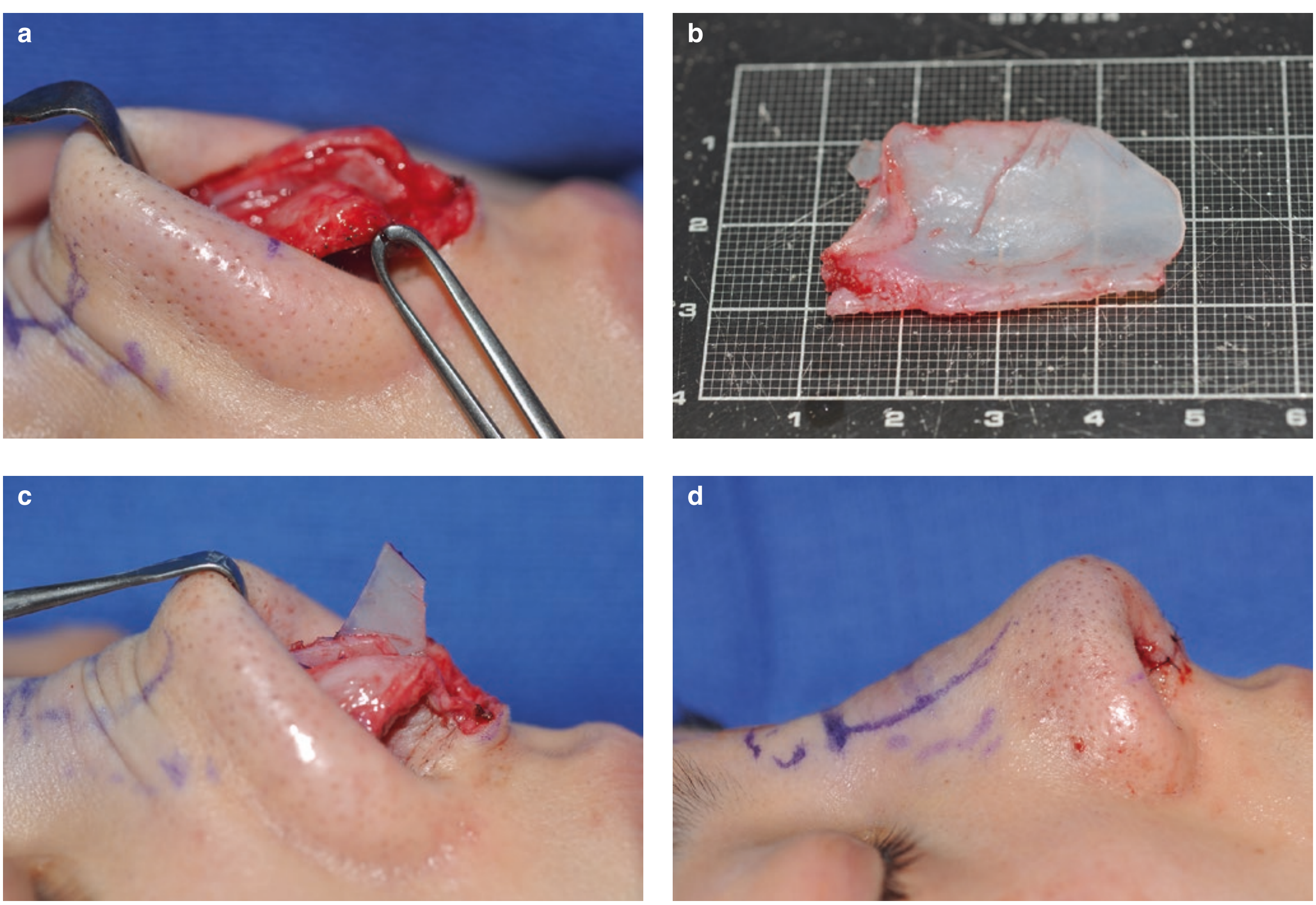


Fig 6.5 (**a–d**) A septocolumellar "tomahawk" columellar strut graft

COLUMELLAR STRUTS (CASE STUDY)

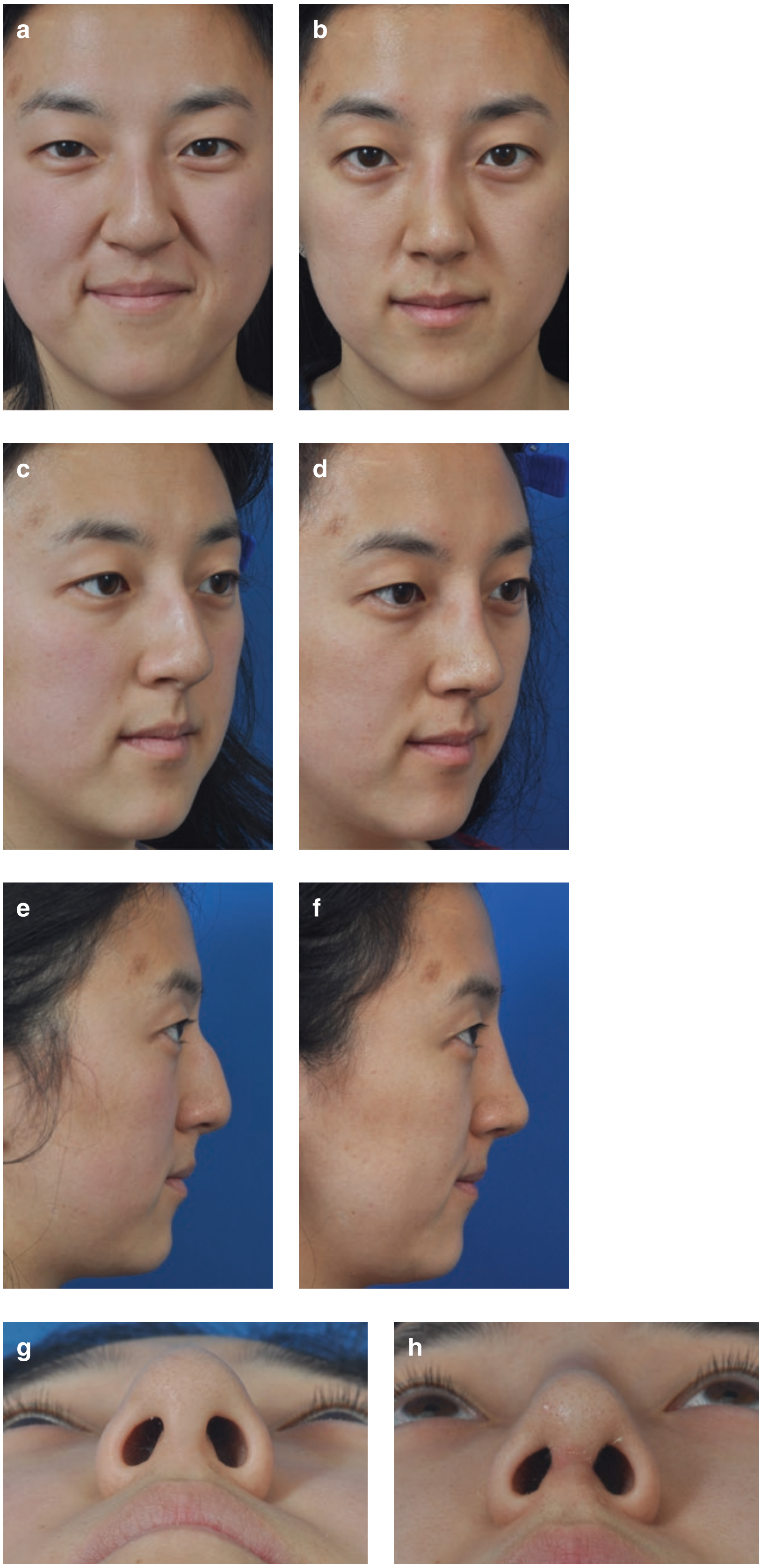


Fig. 6.6 (**a–h**) Patient before and after rhinoplasty

CAUDAL AND SEPTAL EXTENSION GRAFTS

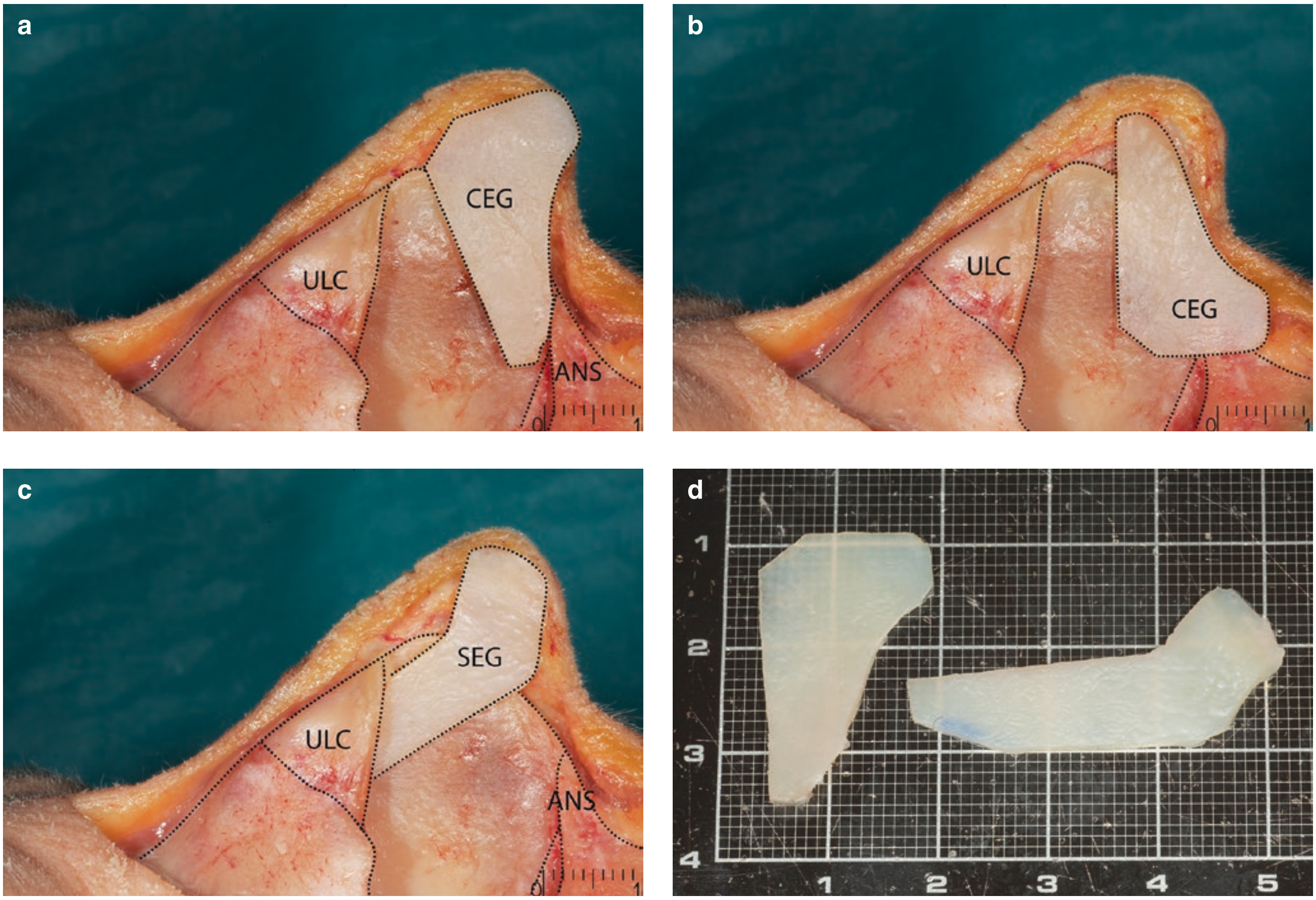


Fig. 6.7 (**a**, **b**) Toriumi's caudal extension grafts (CEG). (**c**) Byrd's septal extension graft (SEG). (**d**) Graft size. *ANS* anterior nasal spine; *ULC* upper lateral cartilage

Toriumi (1995) devised ***caudal extension grafts*** (CEGs) to correct columellar retraction, and then expanded it to correct tip deformities. The graft is often fixed onto one side of the caudal septum, but fixed in the midline caudally to make sure the nose is straight (Fig. 6.8a, b). As applications expanded, the graft was often placed as a direct extension of the septum, which required fixation on either side of the septum with either "splinting grafts" or extended spreaders. Byrd et al. (1997) subsequently introduced the concept of a ***septal extension graft*** (SEG) as a means to control tip shape and projection (Fig. 6.7c). The procedure included (1) fixation of the graft to the middle crura, inferior at their point of divergence; (2) fixation near the domal apposition at the point of maximum projection; and (3) fixation to the anterior septum. The goal of the operation was to control tip shape and position. Ultimately, what began as a method of using septal grafts to influence columellar shape progressed to include tip projection. The use of SEGs has evolved into the use of large pieces of rib cartilage as a major structural graft to control tip rotation and lengthen the nose.

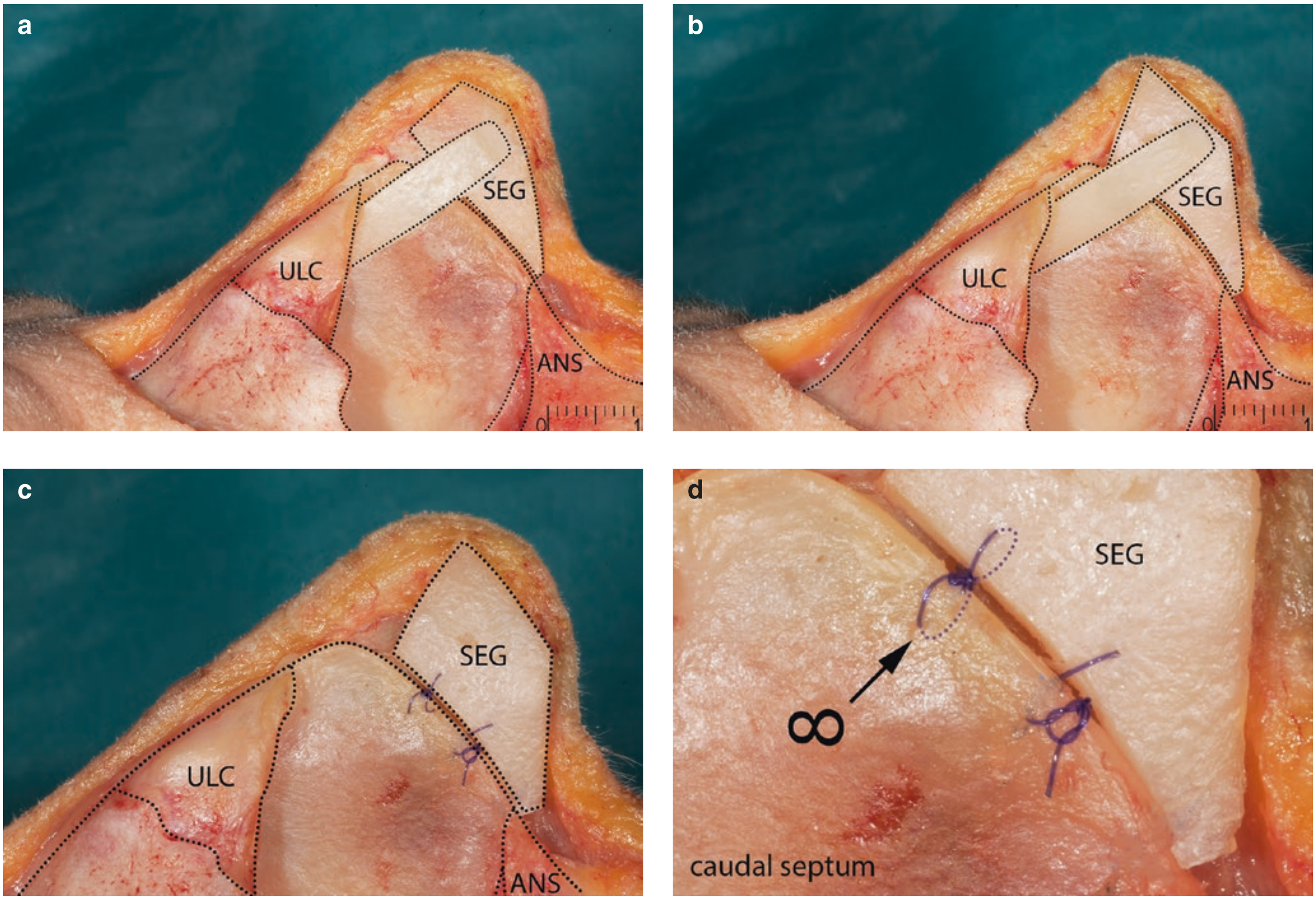


Fig. 6.8 End-to-end SEGs fixed with (**a**, **b**) extended spreaders or (**c**, **d**) figure-of-eight sutures

Pennant grafts are designed to correct the tip that is upwardly rotated owing to a deficiency in septal length or a deformity in the alar cartilages (Fig. 6.8a, b). A combination of extended spreader grafts and a triangular pennant-shaped columellar graft lengthens the dorsal septum to derotate the tip. Usually, septal cartilage is harvested via an open approach using a "top-down" dorsal split, leaving the membranous septum intact. The concept is to lengthen the cartilaginous dorsum by 6–10 mm at the anterior septal angle. The spreader grafts are 20–25 mm long and extend caudally beyond the anterior septal angle by 6–10 mm. The strut is placed between the extended spreaders and sutured into place, which will force the columella downward. Then the routine tip suturing onto the pennant columellar strut is performed.

Davis (2015) uses a dramatically contoured SEG in the infralobule area to stabilize tip position and rotation. Rather than introduce the bulk of extended spreaders into the nasal valve area, he prefers thin strips of perforated pieces of ethmoid or vomerine bone. In most cases, Davis cuts his SEG using a pattern to ensure an accurate contour posteriorly to match the caudal septum and anteriorly to achieve the desired columellar tip angle (Fig. 6.8c, d). Often, the SEG is sutured to the caudal septum using two figure-of-eight sutures.

SEPTAL EXTENSION GRAFT (CASE STUDY)

Analysis: A 35-year-old woman complained about her wide, droopy nose and wanted more refinement. Her round nostrils indicated an absence of septal support, and on tip compression, the patient had a positive septal collapse sign (Fig. 6.9). The patient denied any prior septal surgery, but did admit to two prior sinus operations. The need for a concha and/or rib graft was discussed with the patient.

Operative Technique:

1. Open approach plus right transfixion incision for septal exposure
2. 15- × 8-mm septal harvest was possible. Lower tongue-in-groove was done to control columellar inclination (Fig. 6.10a)
3. The SEG was fixed to the caudal septum (Fig. 6.10b) and the alar cartilages were advanced onto the strut (Fig. 6.10c).
4. Dorsal narrowing with paramedian cuts at 5 mm, then medial oblique and low-to-low osteotomies.
5. Tip sutures with final 9 mm projection from anterior septal angle (ASA) to dome (Fig. 6.10d).

Commentary: At 3 years, the patient's nose is significantly narrower and structurally sound. As there were no nostril sill excisions or alar rim grafts, the change in nostril shape from round to oval confirms the structural support of the tip. Technically, a long septocolumellar graft was not available, so it became necessary to do a modified tongue-in-groove for the columellar inclination and then an SEG graft for tip support.

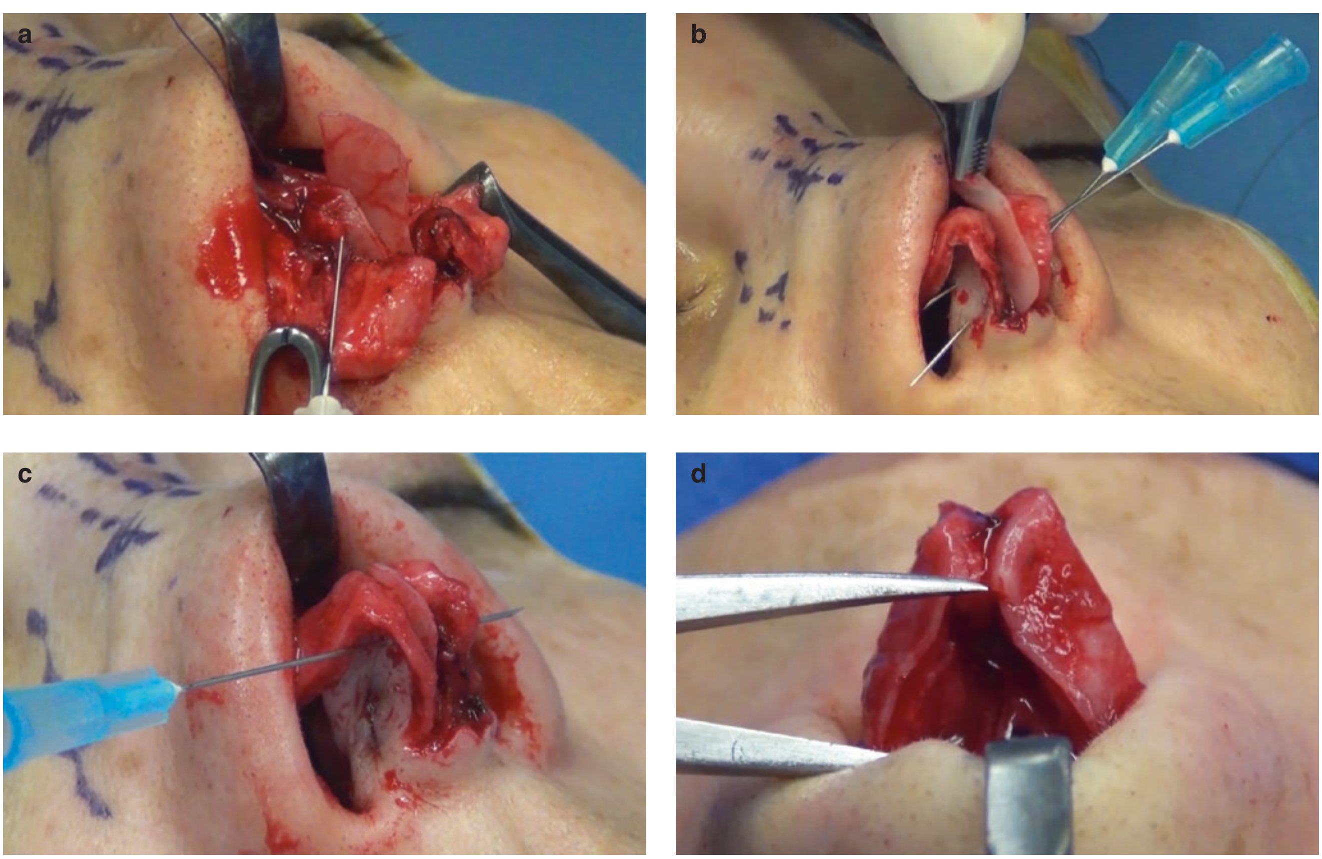


Fig. 6.9 (**a**–**d**) Caudal SEG for tip projection

SEPTAL EXTENSION GRAFT (CASE STUDY)

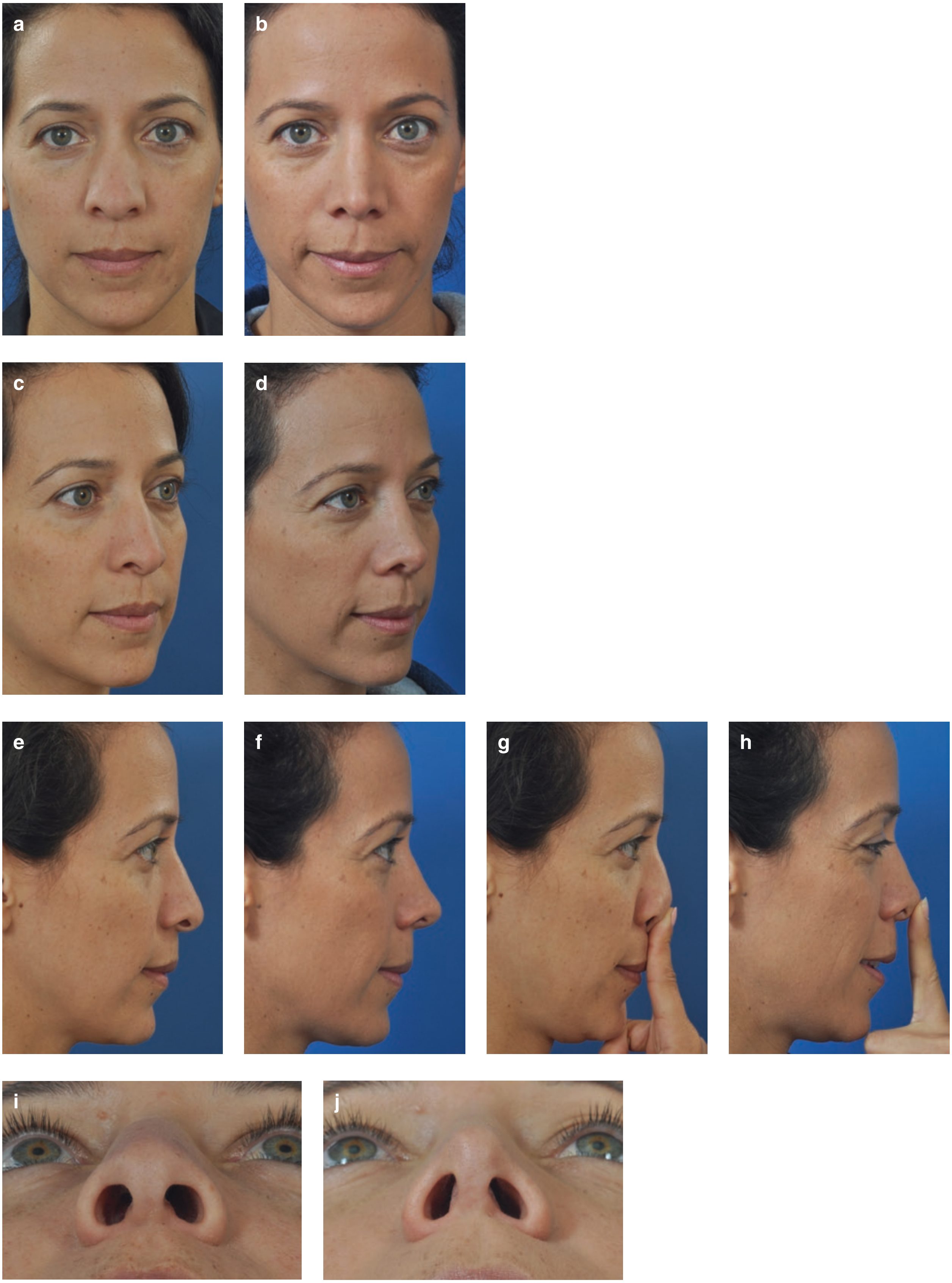


Fig. 6.10 (**a–j**) Patient before and 3 years after SEG placement

CONCHAL GRAFTS: CLASSIC CONCHAL BOWL HARVEST

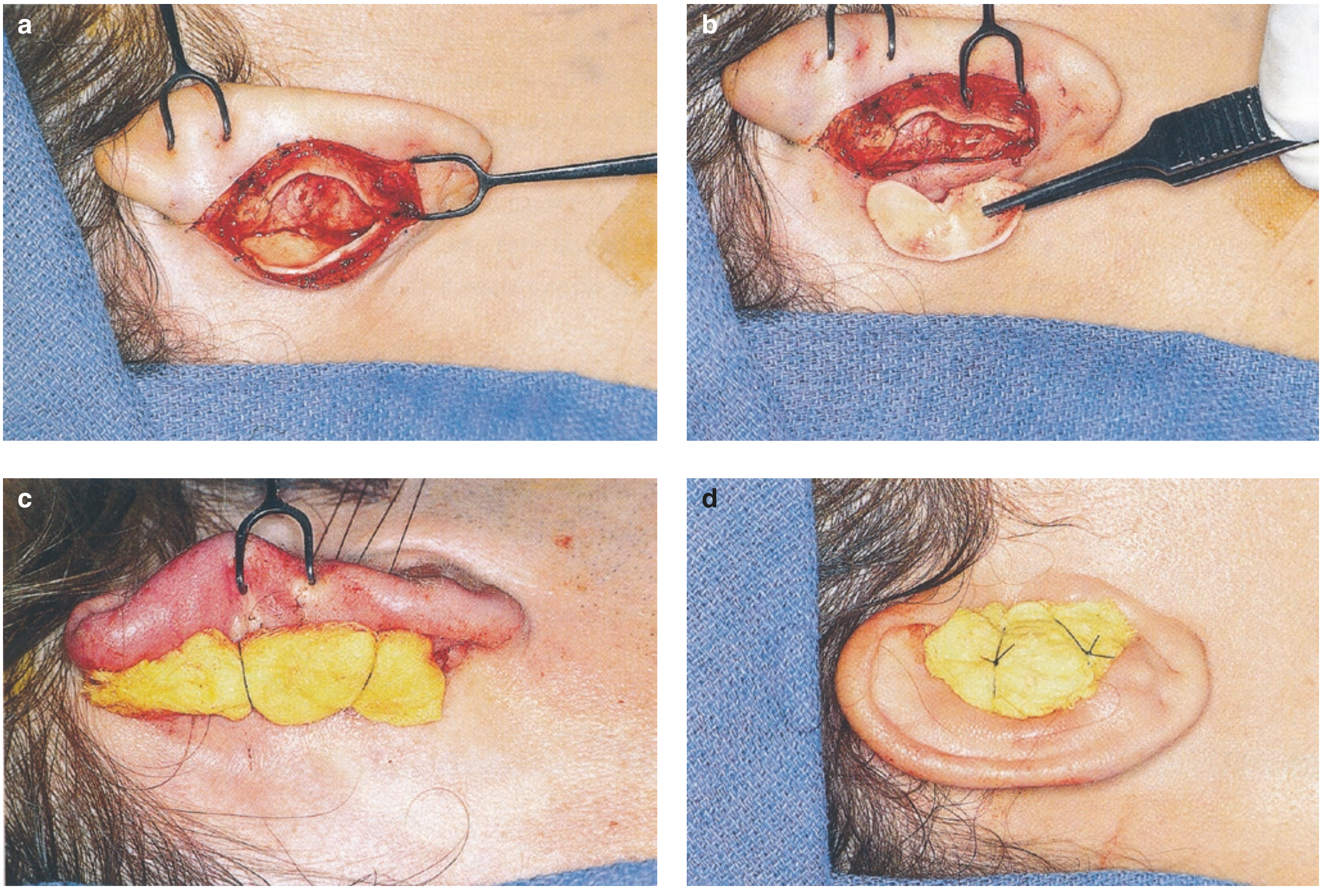


Fig. 6.11 (**a–d**) Classic conchal bowl harvest

Ear grafts can be classified into two broad categories: cartilage grafts and composite grafts (skin and cartilage). The ear is extensively prepped with Betadine to reduce bacterial count. We do not change instruments or gloves and have not had any infections in several hundred ear grafts during the past 20 years. A sheet of Xeroform gauze is cut into two pieces: A large ¾ piece is used to make a mold of the conchal bowl and serves as an anterior bolster, while the small ¼ piece is rolled up like a cigarette for a posterior bolster (Fig. 6.11a, b). The ear is infiltrated anterior and posterior with a total of 5 cc of 1% xylocaine with epinephrine 1:100,000. The skin of the anterior conchal bowl should turn white and balloon away from the cartilage under the force of the injection. With the ear retracted forward, a longitudinal incision is made above the planned incision site of the cartilage, and the posterior concha is exposed. The cartilage is incised below the antihelical fold and the anterior skin is elevated. Once the skin is completely elevated, the entire conchal bowl can be removed. Hemostasis is repeated. Any sharp cartilage edges are rounded off. The incision is closed with a running, locking 4-0 plain catgut suture. The tie-over bolster dressing is applied. Two 4-0 nylon sutures are inserted starting from the conchal surface of the crural strut, passing through the posterior surface of the ear below the suture line and then back through the ear above the suture line. The rolled-up gauze is inserted in the posterior loop and pulled snug both to cover the suture line and to serve as a bolster (Fig. 6.11c) The mold of gauze is then slipped into the anterior conchal bowl and the two sutures tied (Fig. 6.11d). The ear is not drained and no other dressing is applied. The mold is removed at 1 week, concurrent with nasal cast removal.

CONCHAL CARTILAGE GRAFTS

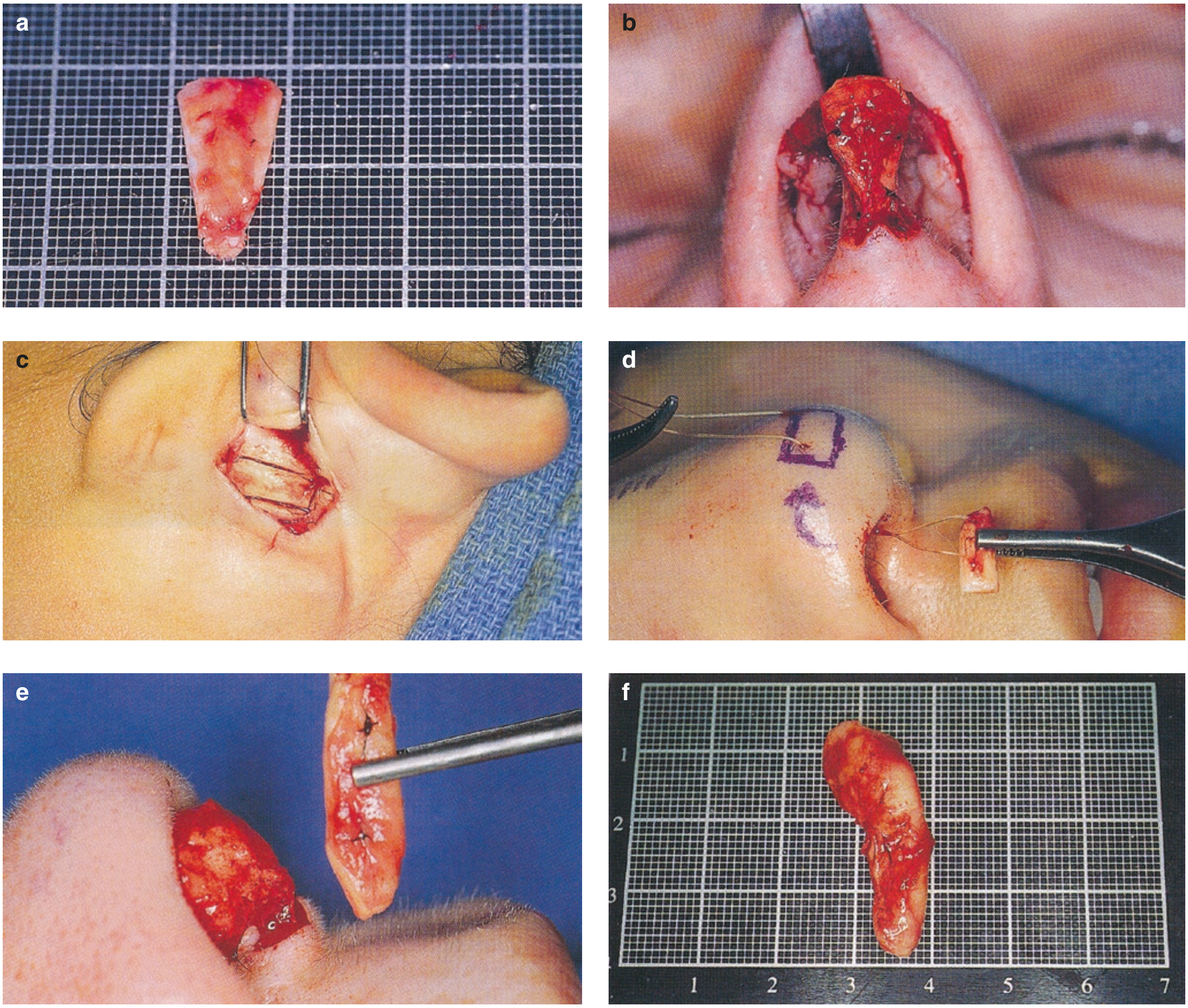


Fig. 6.12 Conchal cartilage grafts. (**a**, **b**) Shield-shape tip grafts. (**c**, **d**) A small domal graft. (**e**, **f**) Columellar struts

The frequency of conchal cartilage grafts has decreased dramatically with the increased use of rib cartilage as a donor source. In addition, acceptance of diced cartilage in fascia (DC-F) grafts has supplanted conchal dorsal grafts, either folded or laminated, because of their unacceptable curvatures and visibility. Given the choice, however, most patients would prefer a conchal harvest to removing a segment of rib cartilage. We continue to use conchal grafts for at least four applications: tip, columellar strut, spreaders, and dicing. Most conchal grafts are done in Asian patients. Shield-shape tip grafts are very effective and are frequently reversed to push the tip-defining points caudally (Fig. 6.12a, b). If it is placed in an over-projecting position, then a" cap graft" is used behind the tip graft. In a revision case, one can insert a small domal graft into a subcutaneous pocket to gain greater definition (Fig. 6.12c, d). Columellar struts are easily made by folding the conchal bowl, either inward for greater rigidity or outward to recreate footplates (Fig. 6.12e, f).

COMPOSITE CONCHAL GRAFTS

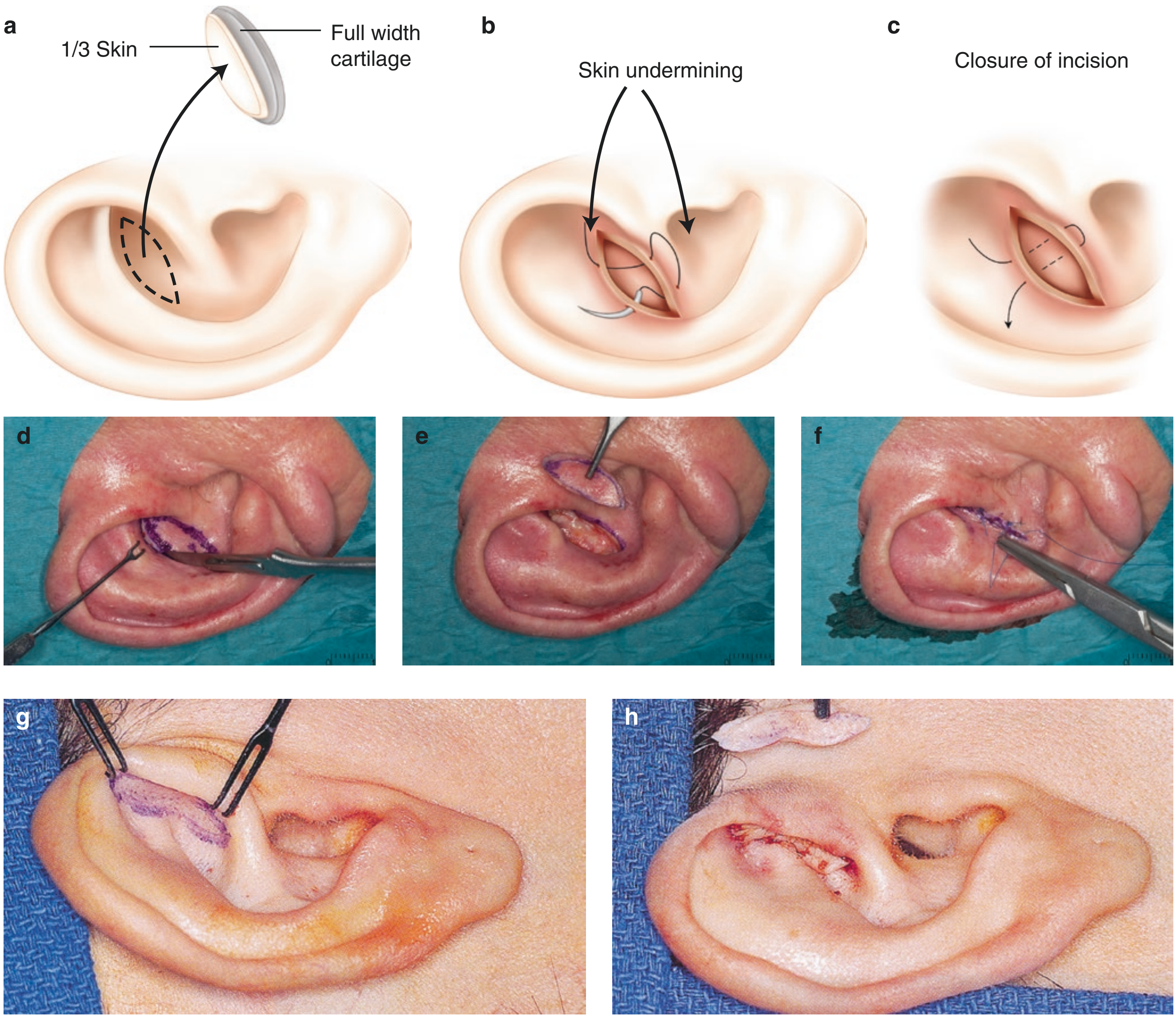


Fig. 6.13 (**a**–**f**) Standard composite conchal graft harvest. (**g**, **h**) Reserve graft from the undersurface of the helical rim

There are three applications of composite grafts, each progressively larger and more difficult: (1) alar rim lowering, (2) vestibular stenosis, and (3) internal valve stenosis. The most common donor site is the anterior surface of the ipsilateral cymba conchae (Fig. 6.13). Traction on the helical root and the antihelix will expose the hidden medial extent of the cymba conchae. The desired graft is then drawn, most often with an elliptical shape. If the cartilage needs to be straight, as for the alar rim, then the upper border is placed lower towards the central strut, whereas if a curve is needed for the vestibule, then the border is moved as high as possible. The skin-to-cartilage ratio will also influence the location and method of closure. When large amounts of cartilage are required, the cephalic incision is the same for both skin and cartilage, whereas the lower border requires a careful skin-only incision and then undermining of the skin downward toward the central strut. The cartilage is then incised inferiorly. The posterior dissection is done above the perichondrium. Hemostasis is meticulous, and any sharp cartilage edges are excised. Closure of the donor site defect consists of the following steps: (1) wide skin undermining; (2) horizontal mattress sutures of 4-0 plain catgut, which picks up centrally the underlying postauricular soft tissue, thus recreating the natural depression; and (3) 5-0 plain catgut sutures at either end. No dressing is required.

COMPOSITE CONCHAL BOWL

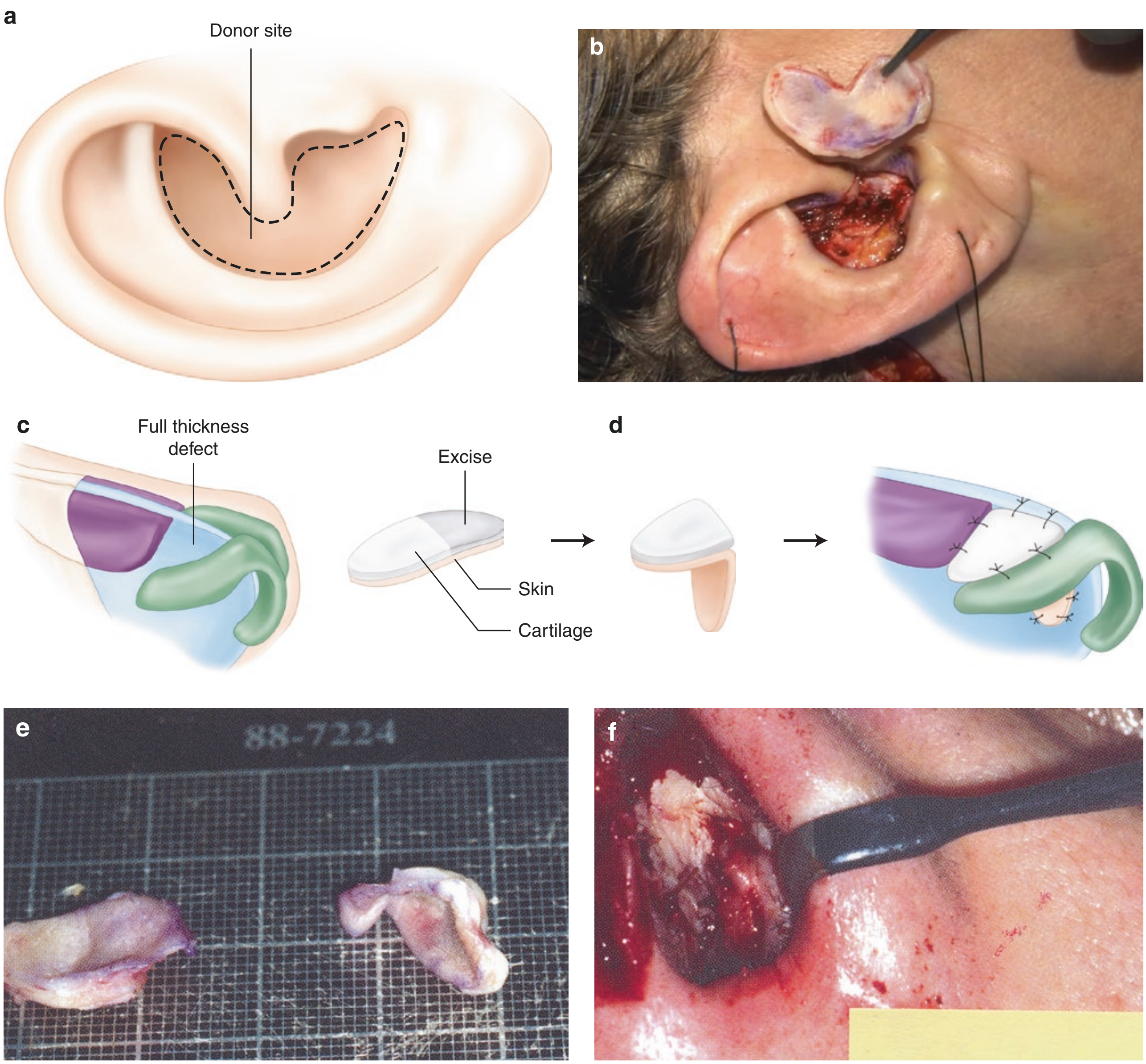


Fig. 6.14 (**a**, **b**) Harvesting the entire conchal bowl. (**c–f**) Creation of composite grafts to reconstruct the internal valve area

A small *reserve* composite graft (12 × 5 mm) can be harvested from the anterior undersurface of the cephalic helical root when the conchal bowl has been previously used (Fig. 6.13g, h), though the donor site often requires a full-thickness skin graft to close the defect. Composite grafts are extremely effective at correcting alar rim notching and lowering the alar rim up to 3 mm. The disadvantages include its inherent greater thickness compared with alar cartilage and "graft show" especially if the incision is made too close to the alar rim or the dissection is done downward toward the alar rim.

On occasion, the entire conchal bowl will be harvested, especially for treatment of the cocaine nose, where large composite grafts are used to reconstruct the vestibule (Fig. 6.14a, b). Once the graft has been removed, the donor site is closed with a full-thickness skin graft taken from the retroauricular area adjacent to the scalp. The graft is sutured into the defect circumferentially and then multiple "quilting" sutures are added to ensure contact with the underlying bed. A standard bolster dressing is added. Composite grafts may be necessary for reconstructing the constricted internal valve angle (Fig. 6.14c–f).

COMPOSITE CONCHAL GRAFT (CASE STUDY)

Analysis: A 53-year-old woman requested reconstruction of her collapsing nose. She had had a rhinoplasty 17 years previously and admitted to using cocaine before and after the surgery. She had been "clean" for 13 years. She felt that her nose was actively collapsing, with the dorsal bump becoming larger and the nostrils flattening. The septum was destroyed, with a virtually total septal perforation and holes into each maxillary sinus. In these cases, it is necessary to restore the structural support of the nose. In contrast to many postoperative saddle noses, structural reconstruction will prove futile unless the mucosal scarring is released and the nasal lining is replaced (Fig. 6.15).

Operative Technique:

1. Harvest of eighth and ninth ribs.
2. Harvest of the entire right conchal bowl as a composite graft. Retroauricular full-thickness skin graft to donor site.
3. Open approach with extension of infracartilaginous incision into an alotomy incision.
4. Gingival incision with subperiosteal dissection. Extensive release of scar tissue.
5. Insertion of spreader grafts with drill-hole fixation to nasal bones. Septal strut fixed to ANS.
6. Insertion of major composite grafts to resurface the entire vestibule and support the alar base (Fig. 6.15d–f).
7. Tip split and insertion of a columellar strut.
8. Application of 4 cc of diced cartilage to premaxilla in each parapyriform and subnasalis region.

Commentary: The true deformity in this case was collapse of the distal half of the nose, with contracture of the vestibule and lobule. Extensive dissection was done between the skin and the scarred superficial muscular aponeurotic system (SMAS) layer. The entire lobule was mobilized from the contracted vestibular lining. The conchal graft measured 18 mm long by 12 mm wide, thereby replacing the entire inner surface of the alar base and allowing the nostril rim to be brought down and restored its normal appearance (Fig. 6.16). At 1 year postop, the vestibule is normal and complete survival of the composite conchal graft has occurred (Fig. 6.15f).

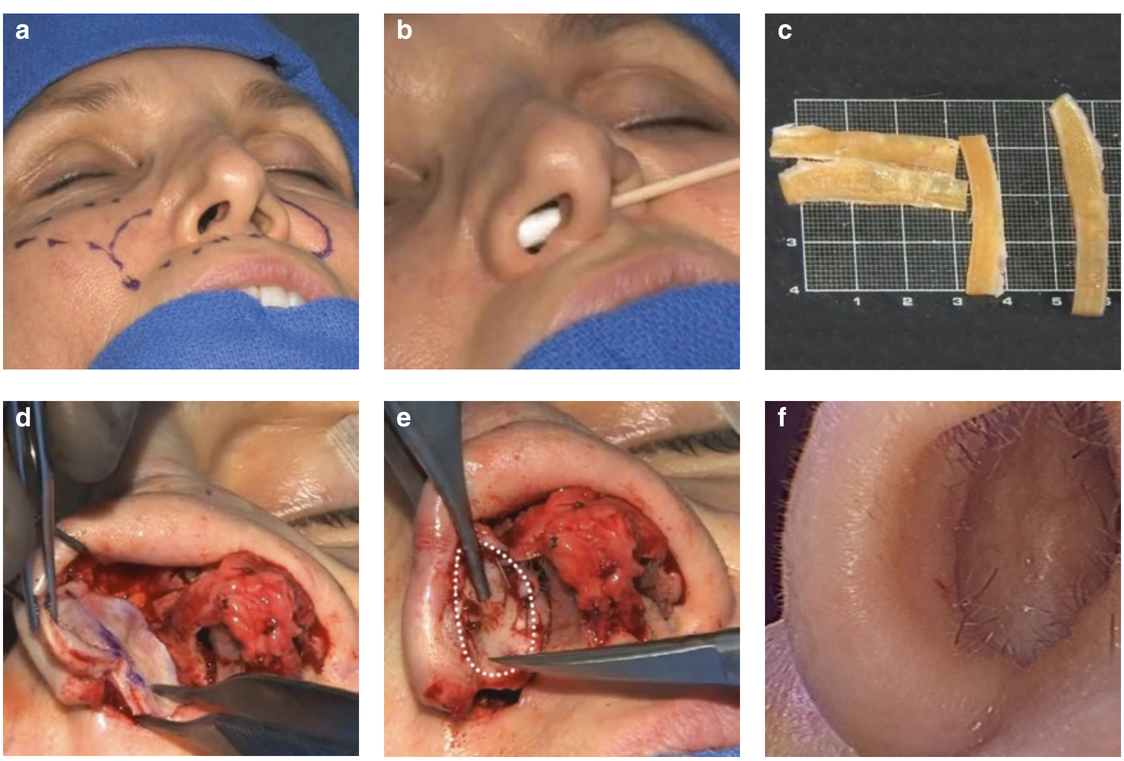


Fig. 6.15 (**a–f**) Composite conchal graft insertion to reconstruct the constricted vestibule in a cocaine-damaged nose

COMPOSITE CONCHAL GRAFT (CASE STUDY)

Fig. 6.16 (**a**–**j**) Patient before (*left*) and 1 year after (*right*) reconstruction using a composite conchal graft

DEEP TEMPORAL FASCIA GRAFTS: HARVESTING TECHNIQUE

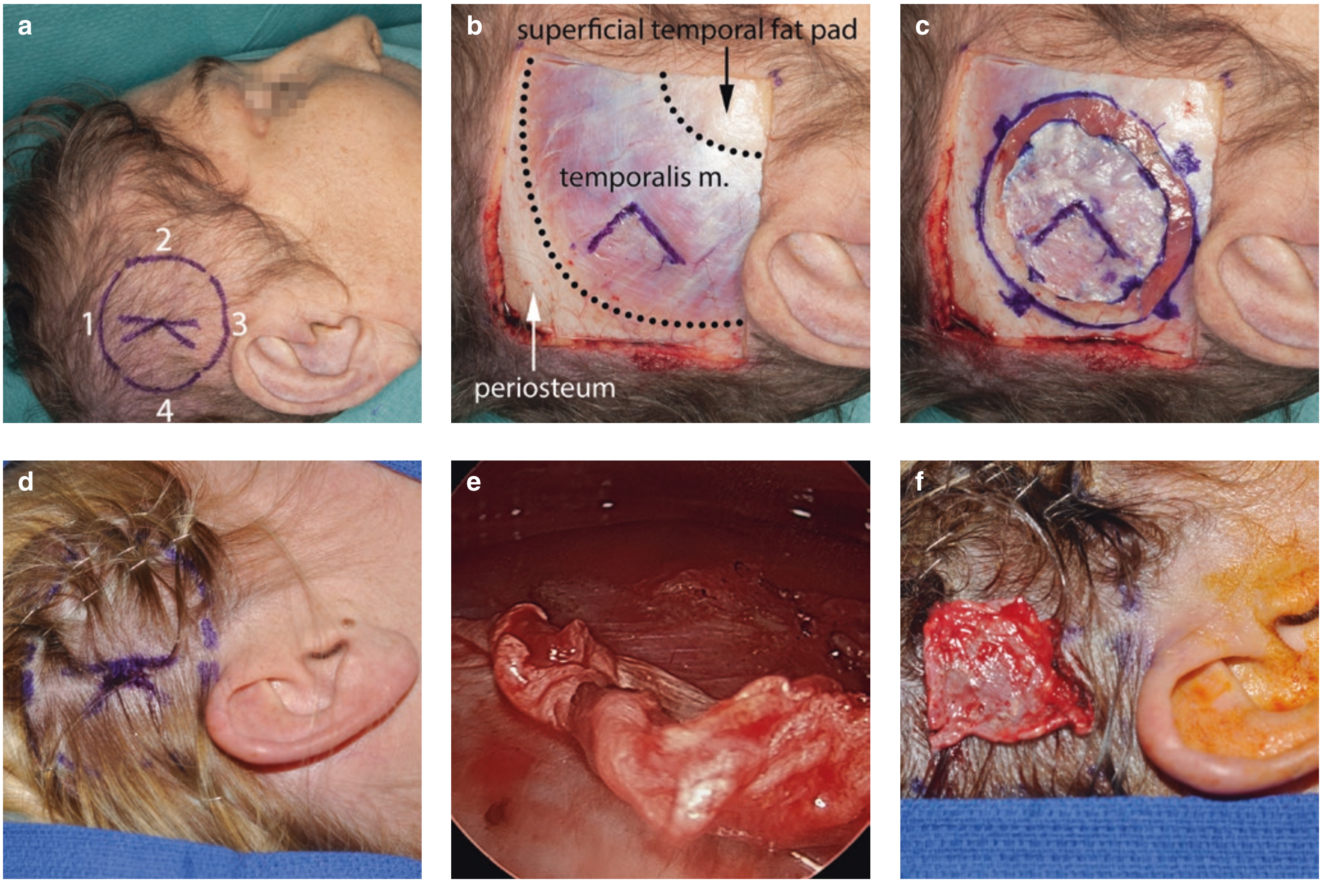


Fig. 6.17 Fascia harvest in a (**a**–**c**) cadaver and (**d**–**f**) clinically. Note: An endoscope is not used routinely, only for illustration purposes

Autogenous fascia is an extremely valuable grafting material for nasal surgery when soft tissue padding is needed, rather than structural support. Deep temporal fascia (DTF) is used exclusively because of its thickness and long-term survival, whereas superficial temporal fascia is too thin and has little long-term survival. A 5 × 5-cm or larger piece of DTF is harvested through a 2.5-cm incision above the auricle (Fig. 6.17a, d). A straight line is drawn 3–4 mm posterior to the line coming up from the tragus, and a posterior V with 1.5-cm limbs is added. The hair is not shaved. The area is injected with local anesthesia containing epinephrine. The incision passes downward to the subcutaneous tissue, which is spread transversely with the scissors. Hemostasis is checked at this point. The superficial temporal fascia is penetrated and the loose areolar layer is found, with the gleaming white DTF underneath. The scalp is then retracted superiorly using two Ragnell retractors. The fascia will be incised as four arcs: (1) superiorly at the junction of the DTF and periosteum; (2) anteriorly at its split, to accommodate the superficial temporal fat pad; (3) inferiorly down to the top of the ear; and (4) posteriorly as far back as necessary, or up to the junction of the DTF and periosteum. As the DTF is incised and rolled forward, one sees the underlying red temporalis muscle (Fig. 6.17e). The scalp is then retracted in each of the other three quadrants and the fascia is incised. A large fascia graft is removed. Hemostasis is repeated. It is important to note that the harvested piece of fascia will shrink significantly once it is removed (Fig. 6.17c). The incision is closed with staples. No drains or dressings are used. Antibiotic ointment is applied. The hair can be washed on the second postoperative day.

USES AND CONFIGURATIONS

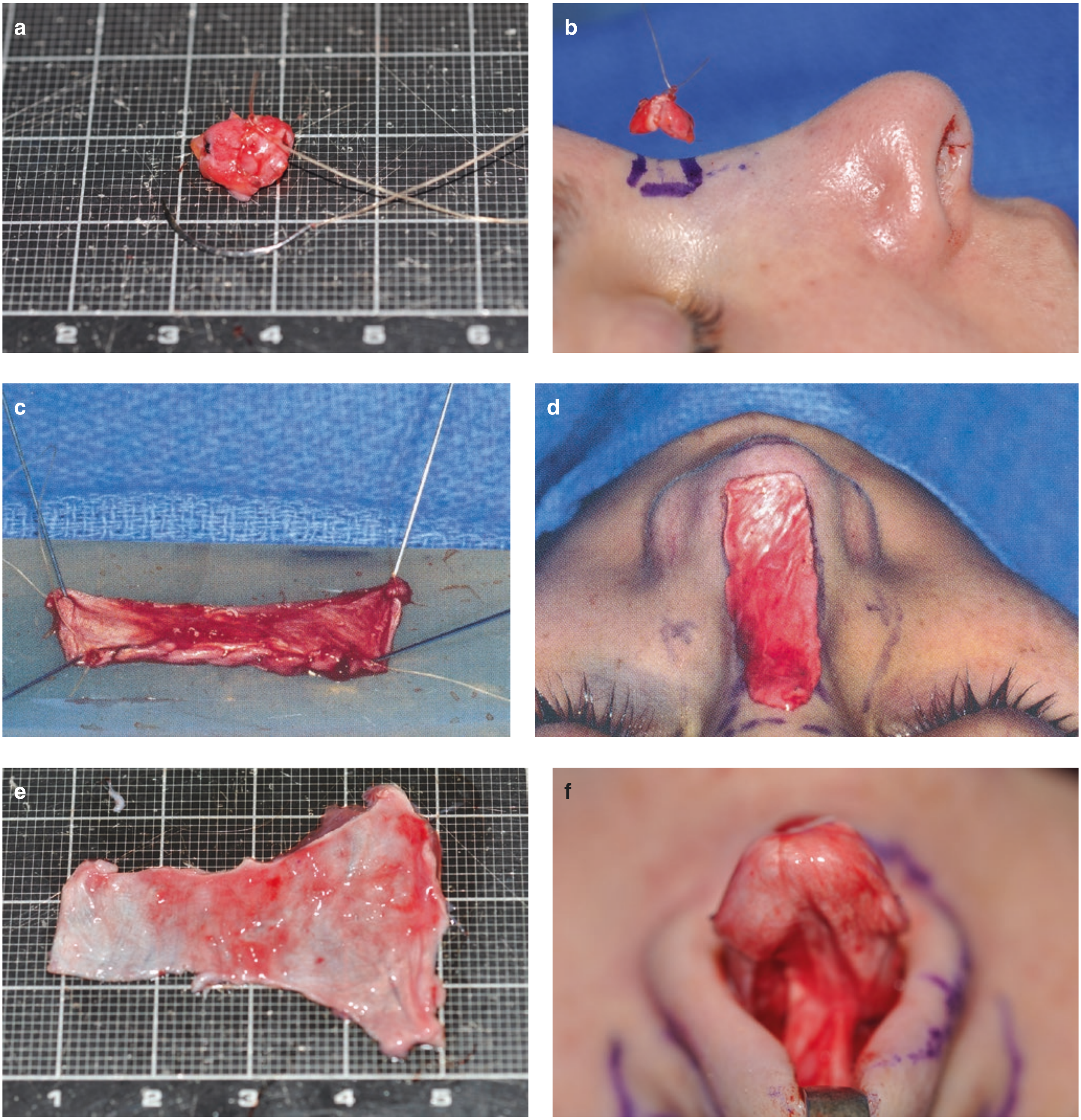


Fig. 6.18 Deep temporal fascia (DTF) applications. (**a**, **b**) Radix graft. (**c**, **d**) Full-length dorsal graft. (**e**, **f**) Fascial blanket

Fascia is utilized in a wide variety of configurations. Virtually all **radix grafts** are simple balls of fascia (Fig. 6.18a, b). One can “overgraft” the area about 20% of cases, as compression will occur. In thin-skin patients, a full-length **dorsal graft** of fascia in a single layer is employed for primary cases and a double layer for secondary patients (Fig. 6.18c, d). When both the radix and dorsum need extra padding, we use a “ball and apron” to fill the radix and pad the dorsum. In secondary patients with extremely thin skin, the entire nose will be relined, using a “**fascial blanket**” graft to avoid the “shrink wrap” effect of thin, scarred skin (Fig. 6.18e, f). Long-term biopsy of DC-F grafts shows that fascia survives completely, and a distinct surgical plane can be found between fascia and skin at 1 year (Calvert et al. 2006). The patient should expect additional postop swelling and avoid massaging the area.

DICED CARTILAGE IN FASCIA (DC-F) GRAFTS

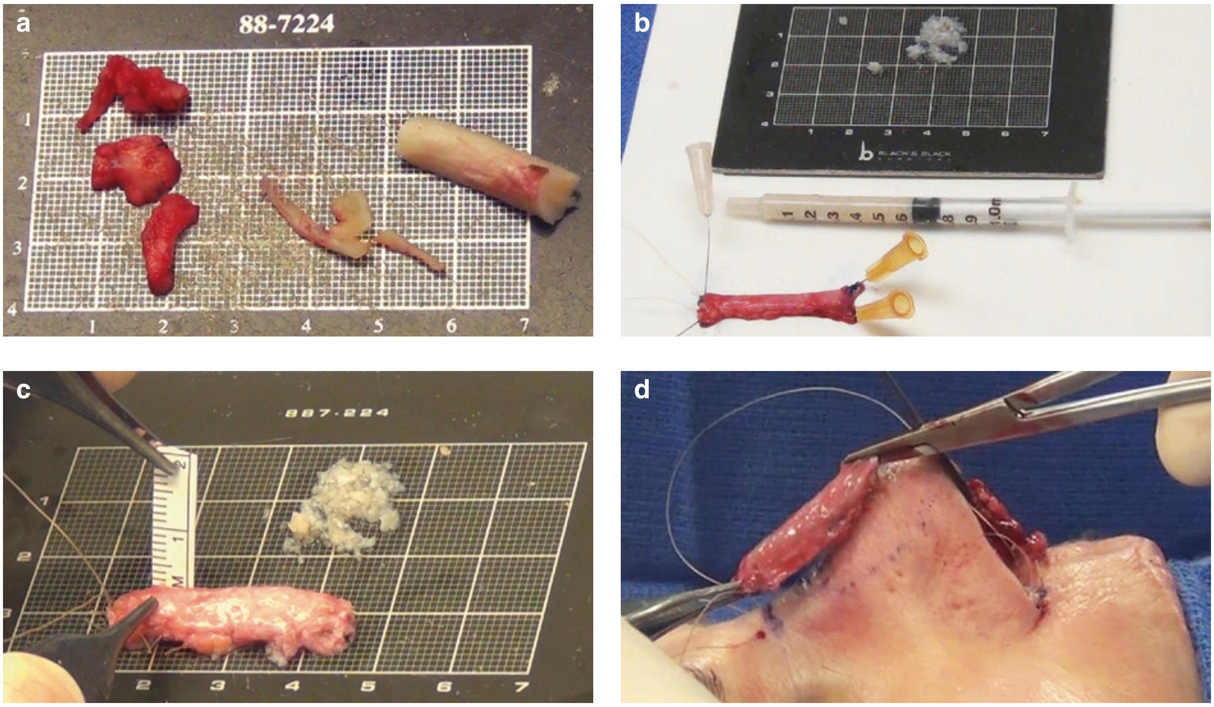


Fig. 6.19 (**a–d**) Step-by-step preparation of a diced cartilage in fascia (DC-F) graft

Diced cartilage in fascia (DC-F) has revolutionized dorsal grafting (Daniel 2002, 2004, 2008). The basic concept is to dice cartilage into small bits (<0.5 mm), which can be put into a fascial sleeve that is slipped into the dorsal defect. The technique is described in detail below (Figs. 6.19 and 6.20), followed by an in-depth analysis of experience gained from over 400 DC-F grafts done in the past 15 years.

Step #1. Fascial Harvest. The largest possible sheet of deep temporal fascia is harvested. The resection extends superiorly to the periosteal junction, anteriorly to the DTF split, then inferiorly toward the concha and posteriorly as far back as possible. If necessary, additional fascia can be harvested from the opposite side.

Step #2. Dicing the Cartilage. Excised cartilage of any source is diced into <0.5-mm bits. In general, the circulating nurse puts on sterile gloves and dices the cartilage into the bits while the surgeon continues to operate. It is important to cut the cartilage with sharp blades (razor, dermatome, #11 blade) without traumatizing it; it should not be morselized or crushed. A 1.0-cc tuberculin syringe is filled with diced cartilage. The plunger is inserted and the cartilage is compressed maximally. The cartilage should be diced so fine that it can pass through the hub—the "spurt test."

Step #3. Constructing the Fascial Sleeve. Measurements of the dorsal defect allow an exact DC-F "construct" to be made on the back table and inserted into the defect. The fascia is pinned on a Silastic block and folded into a sleeve 8–10 mm wide and 20–35 mm long. The cephalic end is sutured at its corners using two sutures of 4-0 plain on SC-1 needles. Then the free edge is trimmed and sutured closed with a locking suture of 4-0 plain. (This is similar to a double-layer dorsal fascia graft.)

Step 4. ***Filling the Construct.*** The syringe is slipped into the open end of the sleeve, which is filled to the desired thickness. The critical step is to achieve very specific dimensions: thickness (1–8 mm), length (10–40 mm) and shape (tapered or uniform). Generally, the nondominant hand is used to mold the diced cartilage as it is slowly injected into the sleeve. Alternatively, one can use an elevator to "stuff" the sleeve, but one needs a solid shape. The length of the dorsal graft is trimmed to the exact length required. It is important to mold the graft to the exact dimensions; do **not** over-graft the nose.

DICED CARTILAGE IN FASCIA (DC-F) GRAFTS

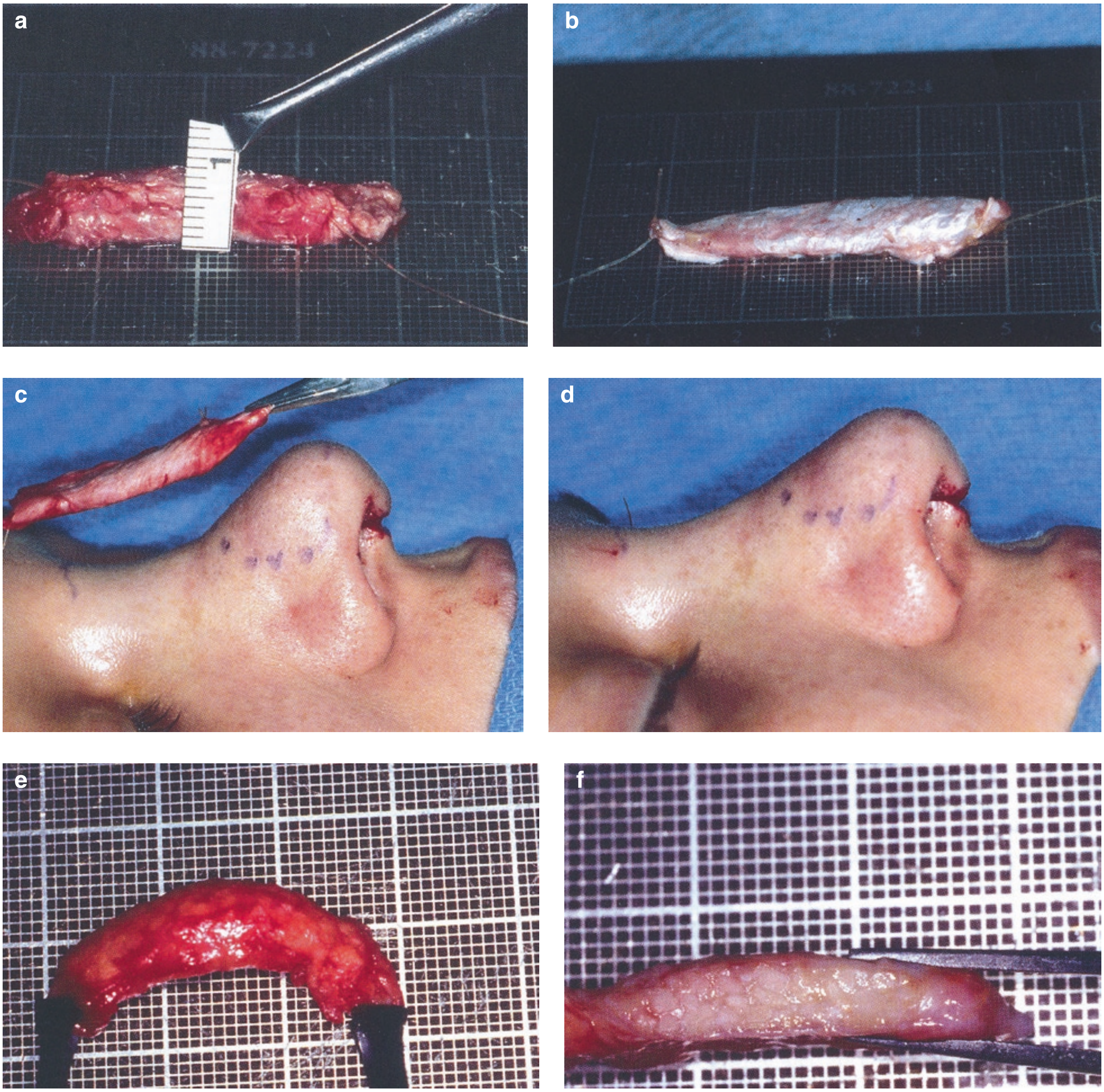


Fig. 6.20 DC-F graft. (**a**) Thick. (**b**) Thin. (**c**, **d**) Tapered. (**e**, **f**) DC-F removed at 1 year for shaping and reinserted. Note: The diced cartilage is visible and immersed in fibrous tissue

Step #5. *Inserting the Graft.* The percutaneous sutures are inserted at the nasion level, and the shaped graft is slipped into the recipient bed. If necessary, diced cartilage can be expressed out of the fascial sleeve. One holds the graft at its cephalic end and then molds it from cephalic to caudal. The graft is then closed and fixed to the cartilage vault with a 4-0 plain suture. The graft should not extend above the nasion. A separate radix graft is used to fill the radix area.

Postop Course. Once the nose is closed, the dorsum is gently taped with Steri-Strips. When the cast is removed at 6 days, the nose is inspected, and gentle molding can be done to ensure a smooth dorsum. If required, the patient is seen every 2 days and the graft is molded up to 14 days. If there is any asymmetry at 1 year, it can be easily shaped by beveling with a #15 blade. Alternatively, the now-solid graft is removed, shaped, and reinserted. As noted in Fig. 6.20e, f, the DC-F graft is solid, and the diced cartilage bits are interspersed in fibrous tissue (Calvert et al. 2006).

DICED CARTILAGE IN FASCIA (DC-F) GRAFTS (CASE STUDY)

Analysis: A 26-year-old woman of Asian descent presented with an acutely infected nasal implant and was receiving intravenous levofloxacin (750 mg QD). She had had a nasal implant inserted 13 months previously, and then a tip graft of cadaver cartilage inserted 1 month previously. The infection began approximately 1 week after the last surgery, and the entire dorsum turned red. Multiple options were discussed, including immediate reconstruction, which the patient preferred. Aesthetically, she liked her nose but wondered if she could have more tip definition.

Operative Technique:

1. Inframammary harvest of the sixth rib. Fascial harvest. Open approach.
2. Removal of a triple-stack cadaver cartilage tip graft. Removal of dorsal silicone graft, and capsular excision.
3. Culture taken and wound profusely irrigated.
4. Insertion of a tomahawk septocolumellar graft. Advancement of alar cartilages onto the strut.
5. Open structure tip graft plus an infralobular tip graft (Fig. 6.21a).
6. Insertion of a "made to measure" DC-F graft slightly bigger than the removed silicone implant (Fig. 6.21b).

Commentary: The concept of immediate reconstruction for the infected nasal implant is based on two principles. First, autogenous tissue tolerates infection better than either alloplasts or cadaver material. Second, it is far better to maintain the size of the soft tissue envelope (STE) rather than simply remove the implant and let the STE scar down. One can also add a small, round DC-F graft to the tip to achieve a rounder infralobule (Figs. 6.21c, d and 6.22).

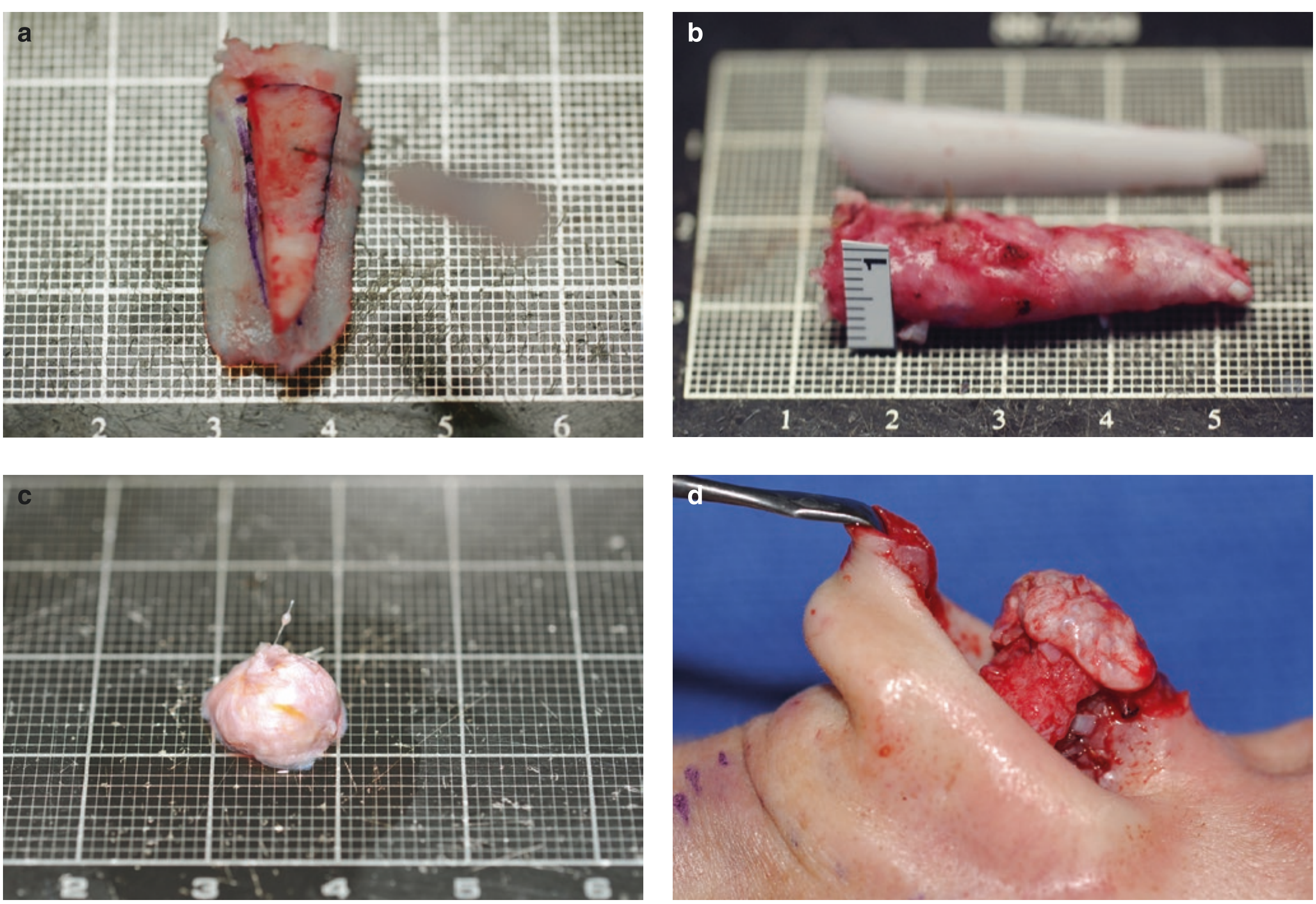


Fig. 6.21 (**a–d**) Reconstruction using DC-F grafts

DICED CARTILAGE IN FASCIA (DC-F) GRAFTS (CASE STUDY)

Fig. 6.22 (**a–h**) Patient before and 1 year after reconstruction using DC-F grafts

FASCIA AND DC-F GRAFT (CASE STUDY)

Analysis: A 15-year-old girl requested a rhinoplasty, as she considered her nose to be too wide and her tip poorly defined. Essentially, she had a wide nose that included the dorsum (dorsal lines), the base bony width (x-points), and the tip (tip points 22 mm apart). In addition, the tip was quite amorphous, with minimal structural definition. Essentially, the dorsal base disproportion would be corrected by shrinking the tip as much as possible and slightly augmenting the dorsum.

Operative Technique:

1. Small chin implant. Fascial harvest. Subcutaneous dissection with maximum STE defatting.
2. Reduction of cephalic lateral crus to 6-mm rim strips. Septal exposure and harvest.
3. Paramedian and low-to-high osteotomies to narrow dorsum from 11 mm to 6 mm.
4. Insertion of columellar strut. Tip suturing: CS, DC, ID, De, TP, LCCS.
5. Shield-shape tip refinement graft of excised cephalic lateral crura, plus a posterior boost graft (Fig. 6.23c, d).
6. Radix graft of fascia. Uniform DC-F graft 30 × 7 × 2.5 mm (Fig. 6.23a, b).

Commentary: The goal was to achieve refinement throughout the nose. Aesthetically, the nose had to be rebalanced beginning at the nasofrontal angle (NFr). The radix graft helps to set the frontal limb, and the DC-F graft elevates the dorsal limb, thus setting the nasion (Fig. 6.24). Technically, one had to narrow the wide nose. The dorsal lines were set at 6 mm with the paramedian osteotomies, and the wide-base bony width was narrowed with the low-to-high osteotomies. The wide, amorphous tip was converted to a more triangular, defined tip using a columellar strut and tip graft. The DC-F graft provided subtle rounding and narrowing of the dorsal contour.

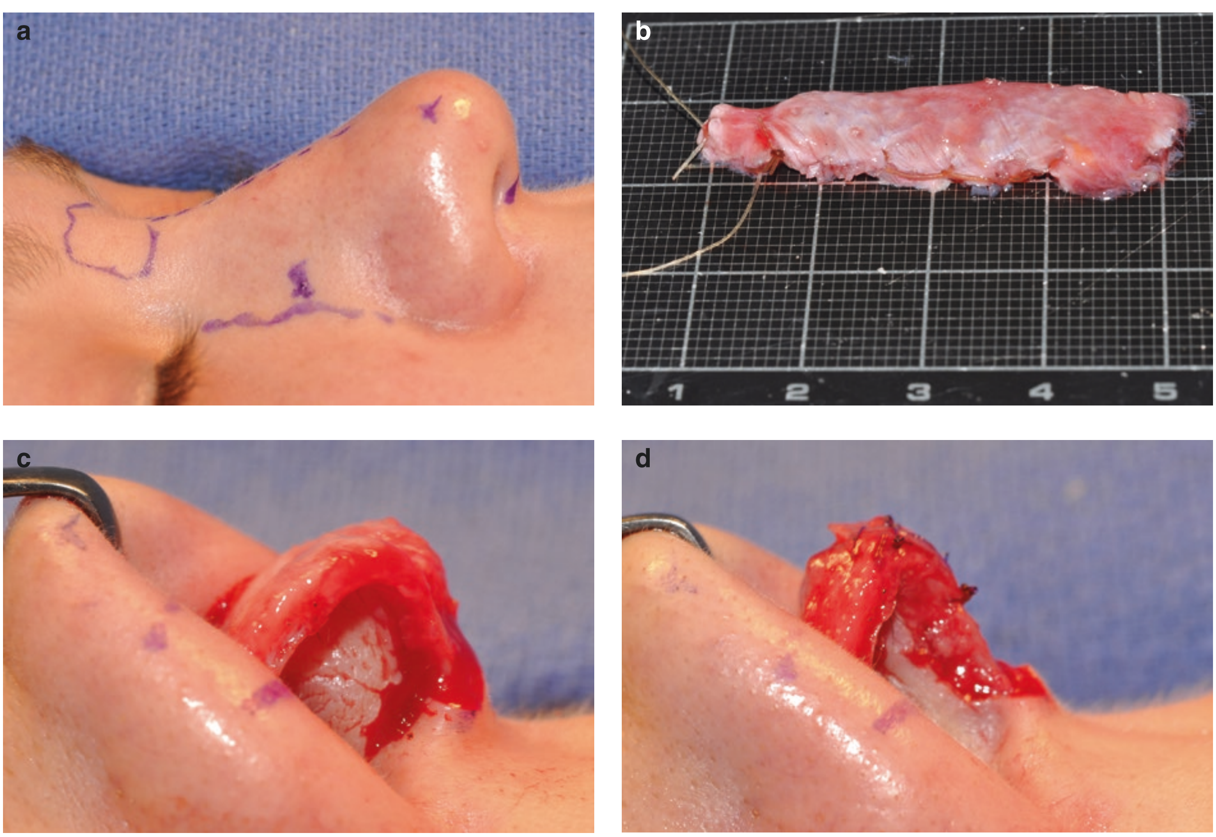


Fig. 6.23 (**a**, **b**) Double fascia insertion in the radix and DC-F dorsally. (**c**, **d**) Crural strut and tip graft

FASCIA AND DC-F GRAFT (CASE STUDY)

Fig. 6.24 (**a**–**h**) Patient before and 1 year after refinement of the nose

RIB GRAFTS: HARVEST

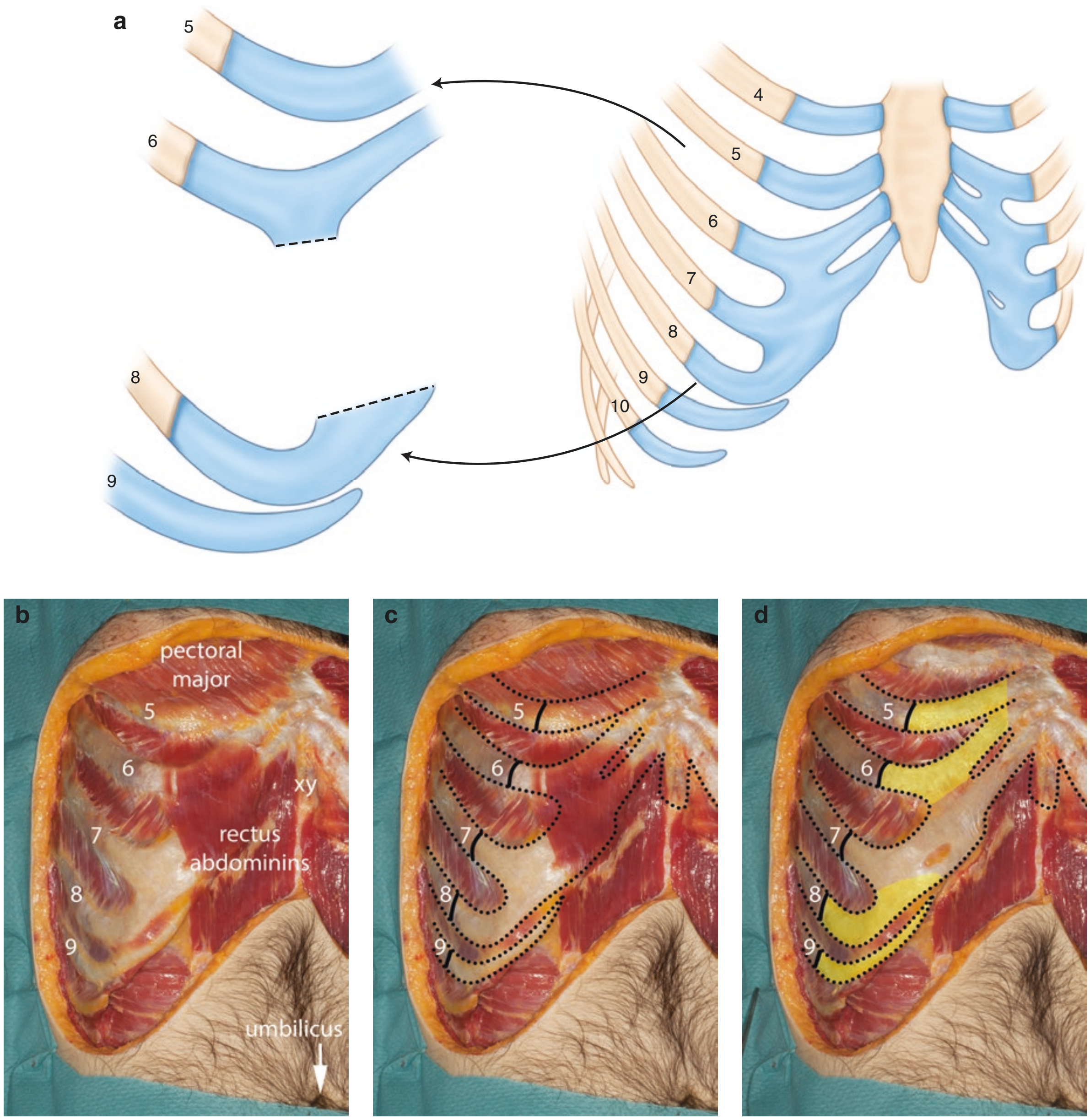


Fig. 6.25 (**a**) Inframammary and subcostal rib harvest. (**b**, **c**) Position of pectoral major and rectus abdominis muscles. (Note: external oblique muscle was removed.) (**d**) Available cartilage from the inframammary and subcostal approaches

The term "rib graft" has a wide variety of meanings in rhinoplasty surgery. There are variations as regards donor site, composition, shaping, and utilization (Daniel 1994, 2002). Initially, rib cartilage was used to fashion a solid dorsal graft, but applications recently have expanded dramatically into a wide variety of grafts. In complex secondary cases, virtually every type of graft will be made from rib cartilage, including tip, alar rim, spreaders, pyriform, and lateral crural strut grafts. Traditionally, rib cartilage grafts for both ear and nasal reconstruction were harvested from the chondrosyncytium of ribs five through seven. In contrast, rhinoplasty surgeons wanted straight segments of rib cartilage. Currently, we use either the ninth and eighth ribs with a subcostal incision, or the fifth and sixth ribs with an inframammary incision, depending upon the patient's preference for the location of the scar (Fig. 6.25). The length of the scar varies from 1.6 mm in thin patients to 3.5 cm in overweight patients. We drain most incisions using a 6-mm suction drain.

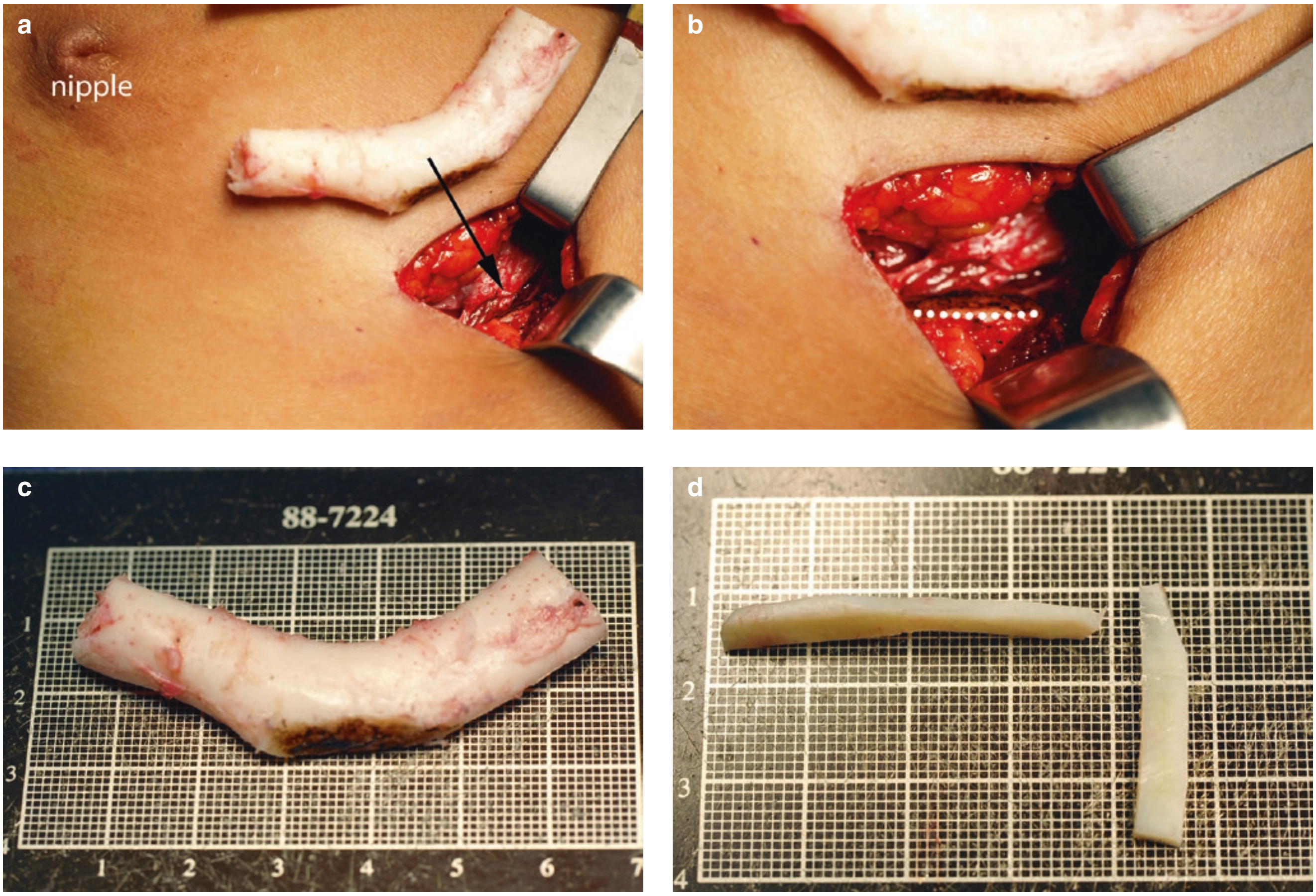


Fig. 6.26 (**a–d**) Inframammary rib harvest from the right side. *Dotted line* indicates fusion between sixth and seventh ribs

Inframammary Approach. It is important to mark the inframammary fold (especially its medial extent) preoperatively with the patient sitting. A patient who has breast implants must be warned that a rupture could occur. The standard incision is 2.5 cm and is placed 1 cm above the inframammary fold, which usually coincides with the fifth costal interspace (Fig. 6.26a). With experience, a 1.5-cm keyhole incision can be used, but it is very restrictive. It is usually placed in the inframammary fold and forces excision of the adherent sixth rib. The wound is infiltrated with 6 cc of local anesthesia. The incision is made and then a cautery is used to dissect down to and through the fascia. The muscles are "split," easily retracted, and thereby left intact, which minimizes postop pain. Although one prefers to harvest a segment of the fifth rib, as it rarely has a cartilage fusion to the sixth rib, its harvest requires greater exposure. In contrast, the sixth rib is fused on its caudal border to the seventh rib in about 95% of cases (Fig. 6.26b, c). Next, one must decide whether to split or excise the anterior perichondrium as a possible graft for padding of the nasal skin envelope. The lateral perichondrium on either side is elevated using curved elevators. The fusion between the sixth and seventh rib is divided partially from anterior to posterior with a cutting cautery. A complete circumferential dissection is done beneath the cartilage at either end. Once satisfied with the length of the graft, the cartilage is divided at either end. The graft is then dissected off the underlying perichondrium from medial to lateral. Once the cartilage graft is removed, the wound is checked for a pneumothorax. Each of the intercostal nerves is blocked with 0.5 cc of 1% Marcaine. The closure is multilayered.

RIB GRAFTS: HARVEST

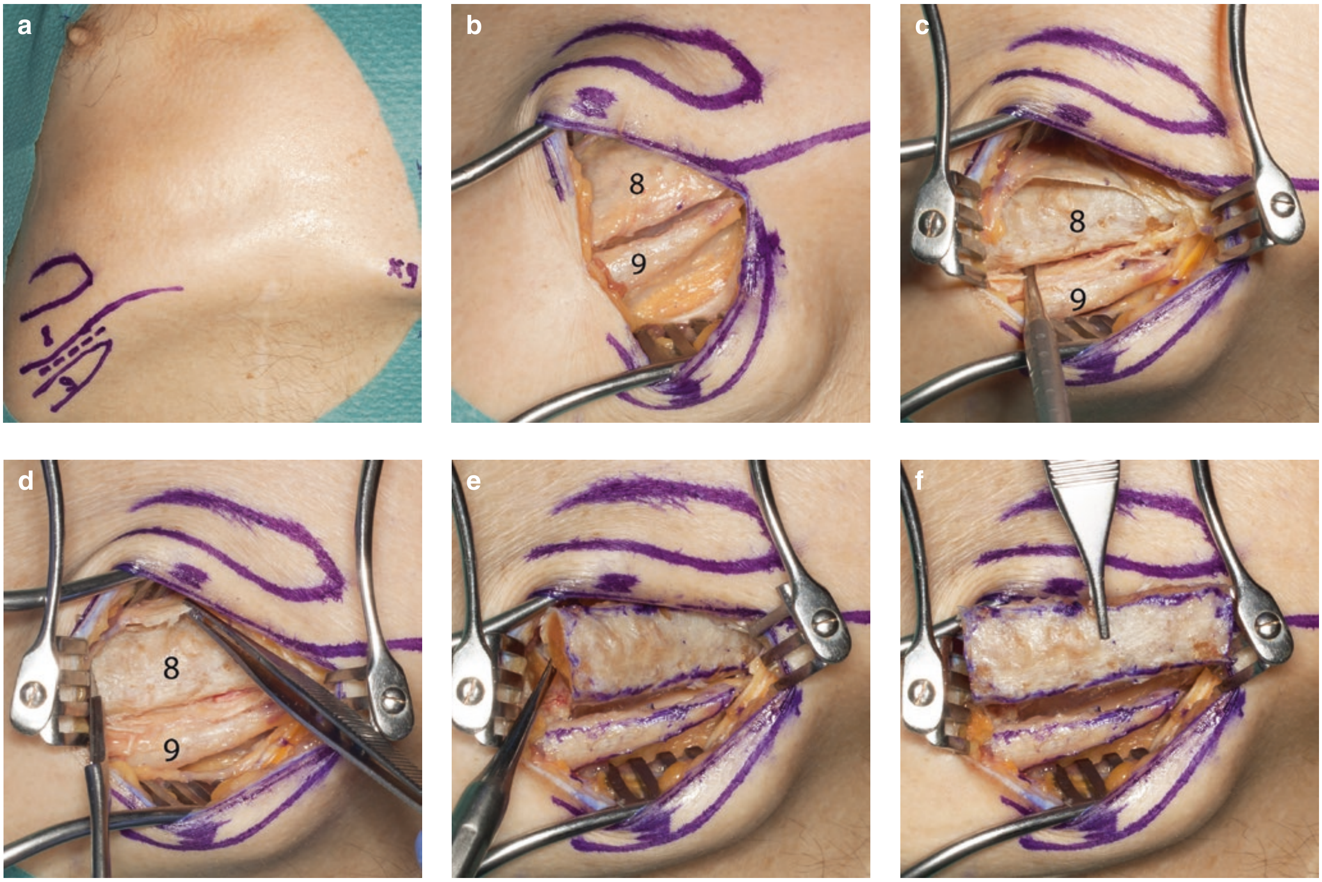


Fig. 6.27 (**a–f**) Harvest of the eighth and ninth rib cartilage for grafting

Subcostal Approach. The ninth rib is the first “floating rib,” so a simple retrograde supraperichondrial dissection is possible. The patient is placed in the supine position with a small sandbag under the hip. The ninth rib tip is palpated, and a 2.5-cm incision is marked between the eighth and ninth ribs, extending laterally from the ninth rib tip. The area is injected with 6 cc of local anesthesia. The initial incision is carried down to the fascia. Palpation is repeated to confirm the rib location, and dissection continues through the muscle and fascia until the distal ninth rib is fully exposed (Fig. 6.27). Although it is possible in thin patients to harvest the entire cartilaginous portion through an incision of less than 2 cm, the incision is usually extended to 2.5 cm, especially when the eighth rib will also be harvested. Once the rib tip is revealed, it is grasped with forceps, and then a retrograde supraperichondrial dissection is done back to the bony junction using the cautery. A curved elevator is placed beneath the palpable bony junction and a #15 blade is used to cut through the junction. Once the graft is removed, the wound is filled with saline and the anesthesiologist maximally expands the chest to test for any pneumothorax.

A segment of the eighth rib is harvested subperichondrially, similar to harvesting the fifth and sixth ribs. The anterior perichondrium is removed for future grafting. It is important to measure and mark the amount of cartilage to be removed. A small, segmental, circumferential elevation of the perichondrium is done at the two ends. If necessary, one can gain additional length medially by dissecting into the syncytium. At this point, the transverse cuts are made, often with a piezoelectric saw, which reduces the risk of penetrating the pleura (Gerbault et al. 2016). The graft is then elevated out of the posterior perichondrial bed without difficulty. Again, the wound is filled with saline and the chest is maximally expanded to rule out a pneumothorax. The wound is partially closed in layers, as extra cartilage can be banked for future use. We currently insert a 6-mm Jackson-Pratt drain.

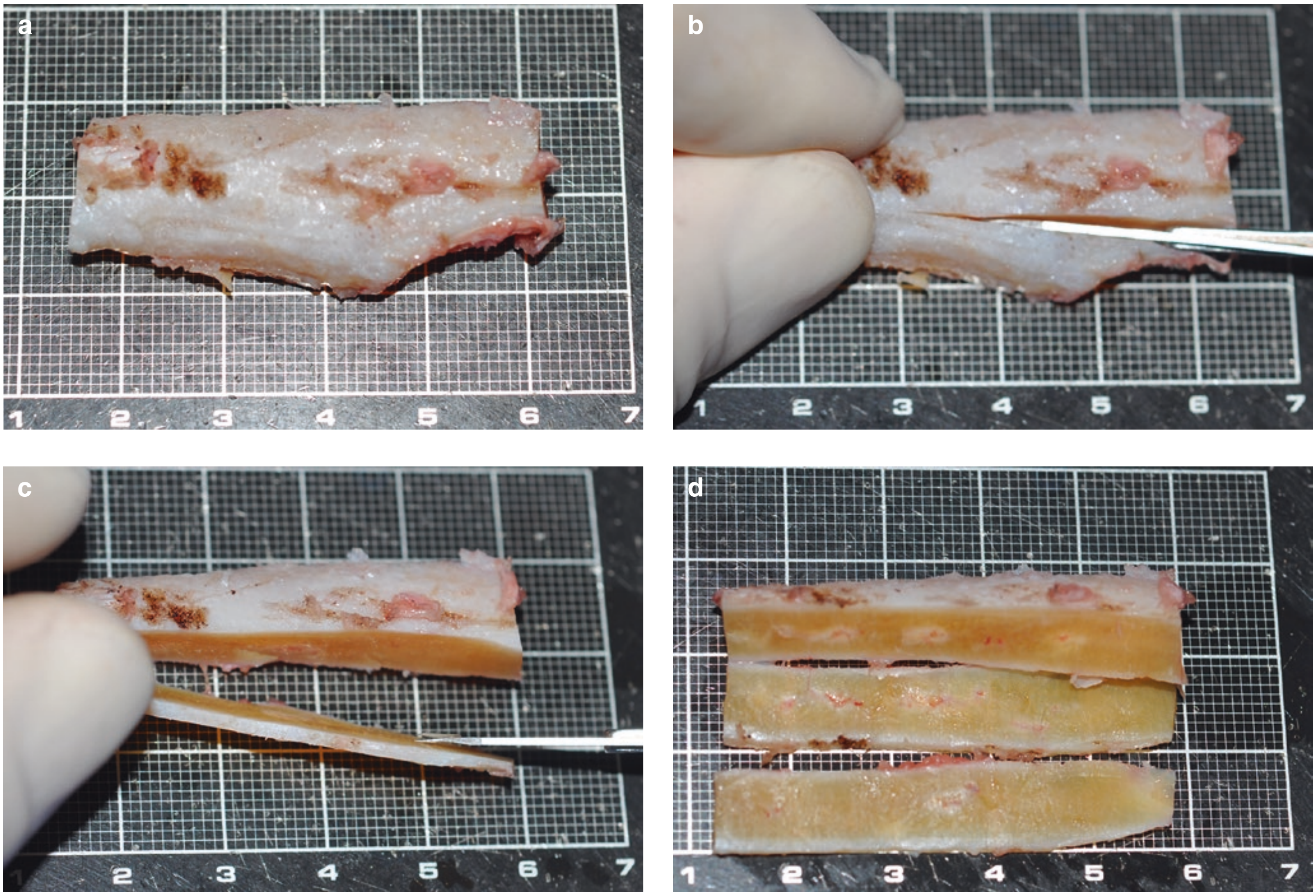


Fig. 6.28 (**a–d**) Carving costal cartilage for extended spreader and septocolumellar grafts in an anterior to posterior direction

For decades, surgeons were obsessed with carving a solid dorsal graft from rib cartilage, but long-term problems of warping and visibility plagued the procedure. Warping was supposedly controlled by "balanced cuts" on the central core of the rib. Gunter and Friedman 1997) attempted to control warping with threaded K-wires, but this approach failed over the long term and is no longer recommended. Calvert et al. (2014) realized that if one cuts the rib from anterior to posterior, the result will be thin, straight strips of rib cartilage with little risk of warping. First, the lateral edge of the rib bloc is cut off to create a straight edge (Fig.6.28a, b). Then it is possible to cut a large number of straight strips of variable thickness (1–3 mm) (Fig. 6.28c, d). These ***rib strips*** can be turned into a wide variety of grafts: columellar, tip, spreaders, septocolumellar, lateral crural structure, lateral crural extender, alar rims, etc. Any small pieces are set aside and can be used for diced cartilage. The strips are placed in a saline basin for 30 min to rule out any warping. If there is any curvature, it is taken advantage of, as spreaders are curved centrally similar to a parenthesis, and lateral crural strut grafts curve into the airway. Based on our experience of the past 5 years, virtually all grafts made from rib cartilage are the equivalent of or superior to those made from septum—a major change from prior decades.

SPREADERS, SEPTAL STRUTS, AND COLUMELLAR STRUTS

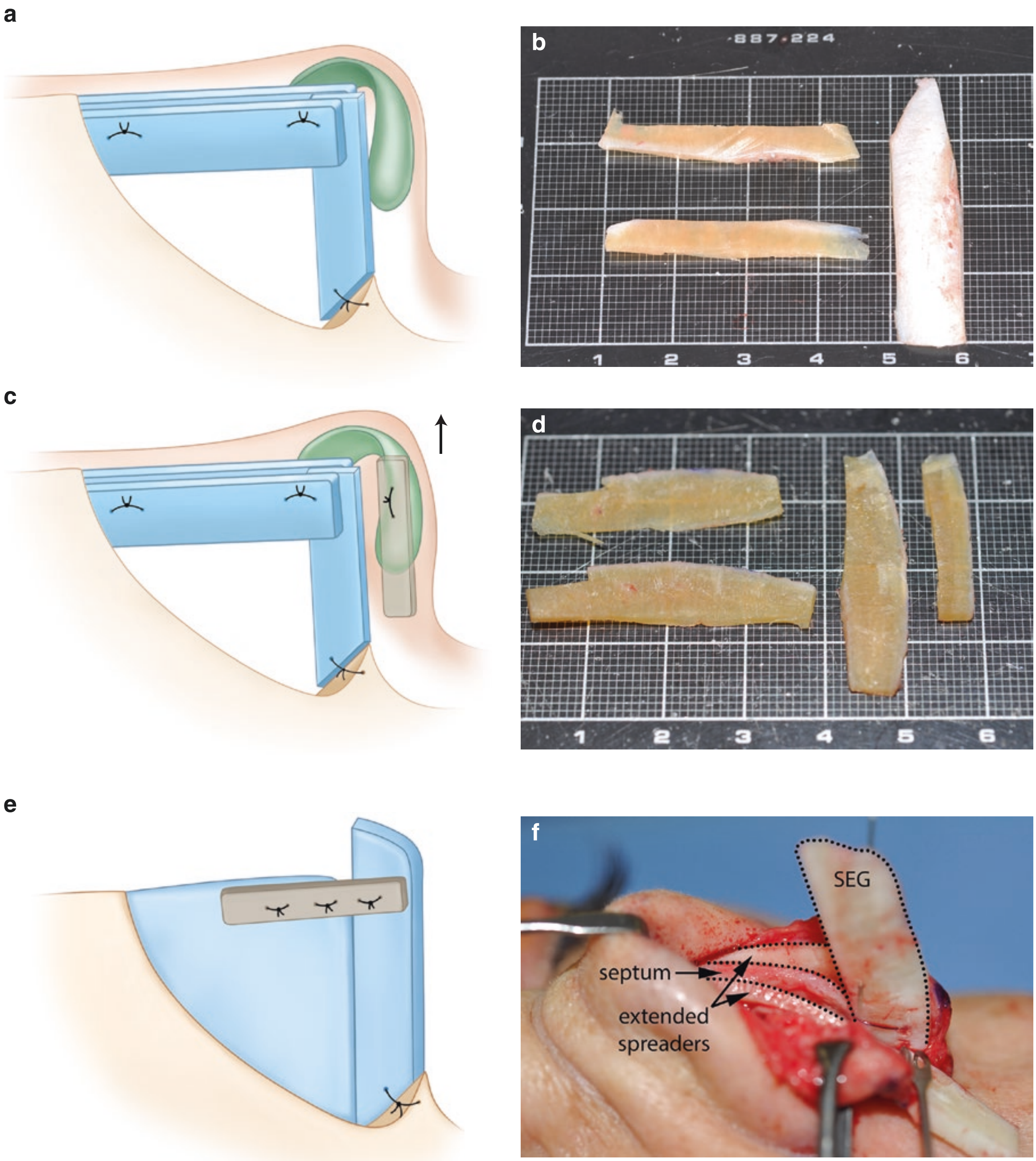


Fig. 6.29 (**a**, **b**) Standard spreaders with septal strut. (**c**, **d**) Standard spreaders, septal strut, and columellar strut. (**e**, **f**) Extended spreaders, septal extension graft (SEG) sutured to the caudal septum

The ability to carve a large number of straight rib strips of variable width allows the surgeon to select the ideal graft for the recipient site. *Spreader grafts* can be of various widths and can be tapered longitudinally. Their length can be short (20 mm) for use as "stabilizing grafts" between an intact septum and a caudal SEG. Standard-length spreader grafts are often in the 30-mm range and 1–3 mm thick. Extended spreader grafts are as long as possible and are notched cephalically to go under the bony vault. *Septal struts* are shorter (20 mm) but wider (10 mm) than *columellar struts* (30 × 3 mm). Shaping of the grafts is critical (Fig. 6.29). One should not hesitate to "laminate" the grafts by placing them in a parenthesis configuration and then suturing them together with 5-0 PDS.

OTHER RIB GRAFTS

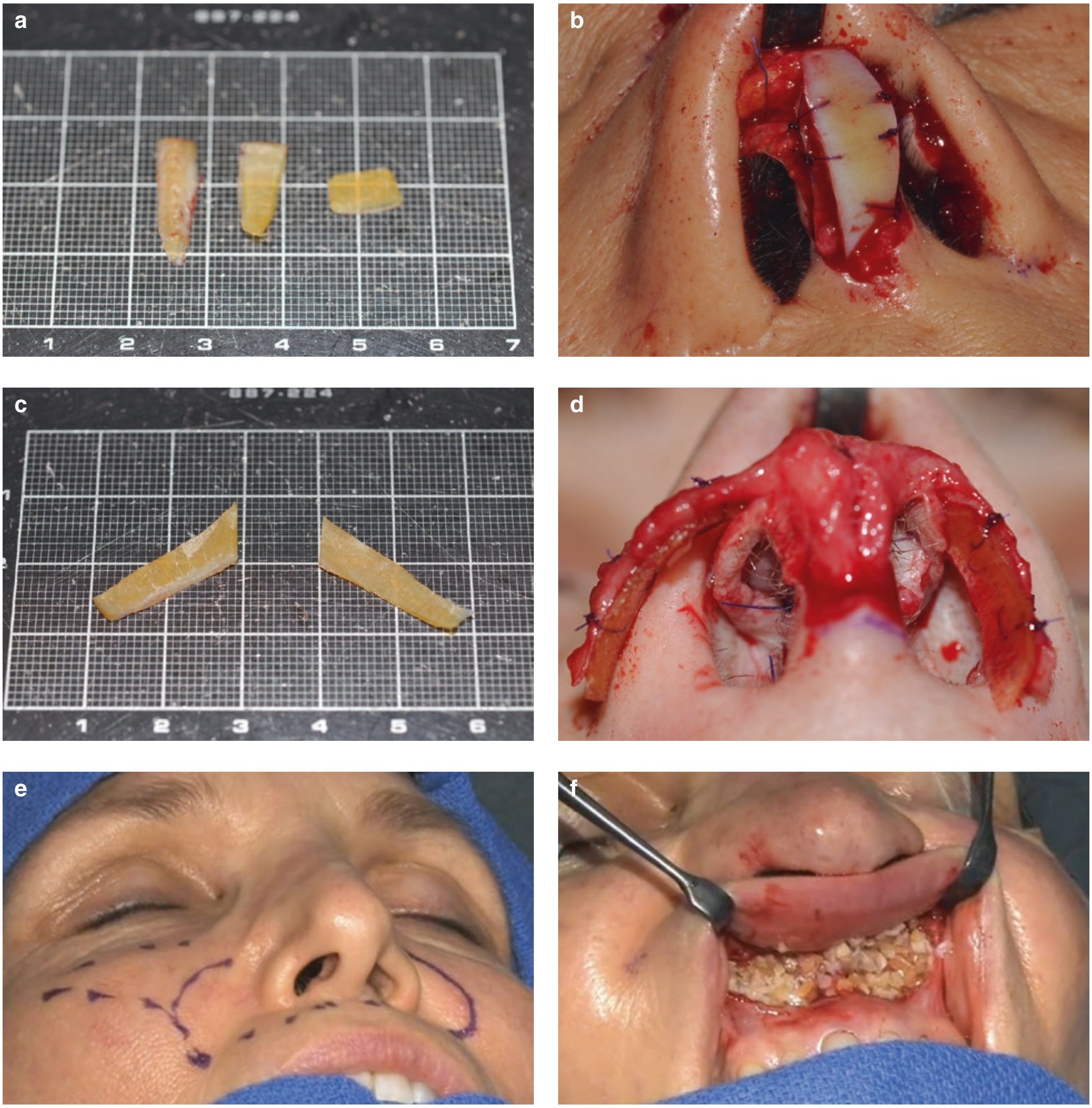


Fig. 6.30 (**a**, **b**) Tip grafts. (**c**, **d**) Lateral crural grafts. (**e**, **f**) Diced cartilage used to support the alar base

One of the great misconceptions about rib grafts is that they are difficult to shape, but nothing could be further from reality. The outer cortex, which often has been removed to cut the strips, is often perfect for tip grafts. Full-length tapered shield-shape grafts (20 × 8 mm) or short domal/infralobular grafts (8 × 4 mm) are easily obtained (Fig. 6.30a, b). The edges are usually heavily beveled. Lateral crural grafts are carved to fit the defect (Fig. 6.30c, d). It should be noted that these grafts can vary in purpose from lateral crural structure to lateral crural extender to lateral crural replacement grafts. All of these grafts are tapered medially and thicker laterally. Diced cartilage grafts (DC) are placed throughout the nose and peripyriform area. Cartilage scraps are diced, either fine for DC-F grafts or coarse, for augmenting the pyriform area (Fig. 6.30e, f). These coarse DC grafts are inserted subperiosteally onto the surface of the maxilla below the alar bases and across the entire subgingival area.

RIB GRAFT (CASE STUDY)

Analysis: A 53-year-old man complained of nasal obstruction and deformity. By history, the patient had fallen from a tree at age 11 and had a rib reconstruction at age 35. The result was satisfactory at best. On examination, the nose had the appearance typical of many solid dorsal grafts: It looked as if a toothbrush handle had been placed under the skin. Because the nose was stable and did not saddle on tip compression, the operative plan was to insert a major columellar strut and augment the dorsum following resection of the upper portion of the prior rib graft.

Operative Technique:

1. Harvest of a portion of the eighth and ninth rib. Fascia harvest. Open approach.
2. Radix portion of prior rib graft removed. Major crush cartilage grafts removed from left side (Fig. 6.31a).
3. Small columellar strut removed, replaced with 25 × 12-mm septocolumellar graft (Fig. 6.32b).
4. Alar cartilages advanced onto strut. Plumping graft placed in columellar base.
5. Radix graft of perichondrium. DC-F dorsal graft fabricated 35 mm long × 6 mm thick (Fig. 6.31c).
6. Mucosal space graft (20 × 7 × 1.5 mm) of thin costal cartilage placed on left side.

Commentary: Essentially, the operation consisted of inserting an *aesthetic layer* of a *composite reconstruction* (Fig. 6.31d). As seen at 3 years (Fig. 6.32), the nasal dorsum appears quite normal, with very natural dorsal lines. One can easily see the difference between a standard crural strut and a major septocolumellar graft (Fig. 6.31b). Excision of the cephalic solid rib graft eliminated the radix deformity and allowed a "uniform" DC-F graft to be inserted. Again, it is important to note that a separate radix graft of perichondrium was used for the frontal limb of the nasofrontal angle (NFr), and the DC-F stopped at the nasion, thus creating rather than obliterating the NFr. The preoperative saddle profile is completely corrected, as is the nasal obstruction.

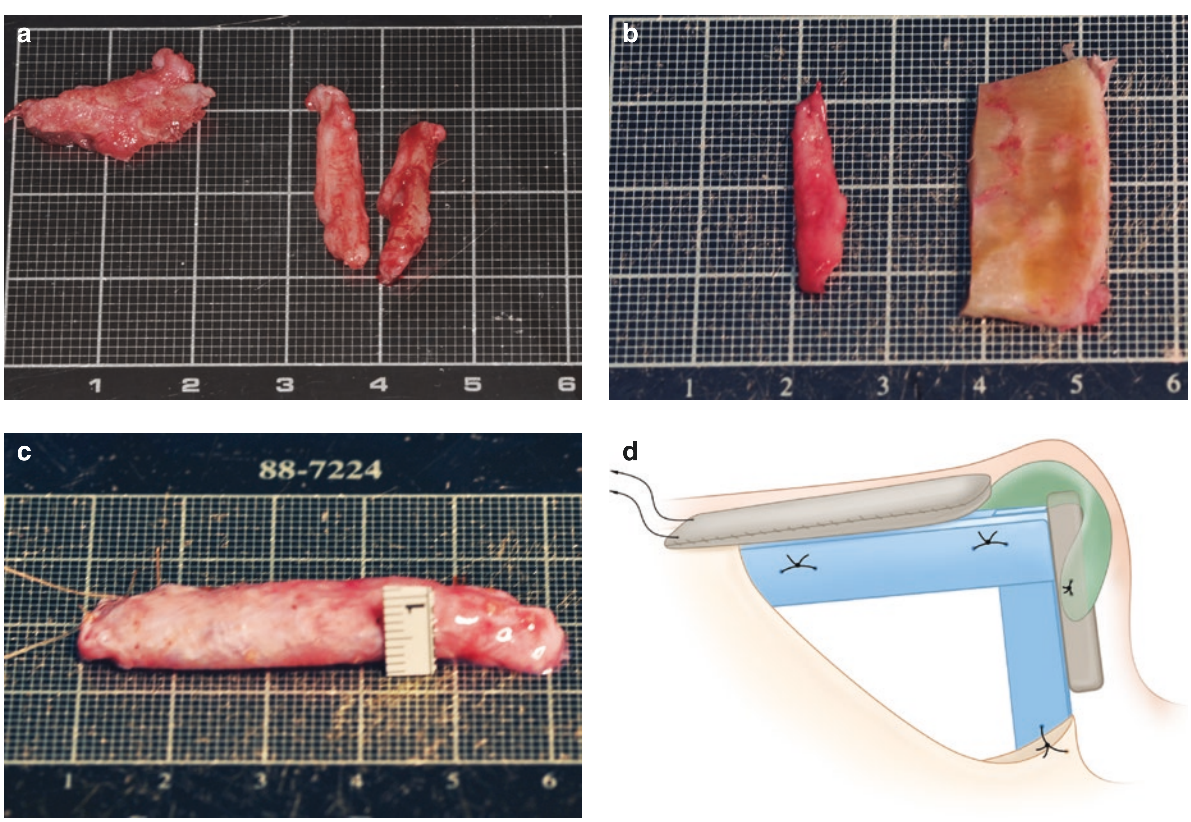


Fig. 6.31 (**a–d**) Rib graft

RIB GRAFT (CASE STUDY)

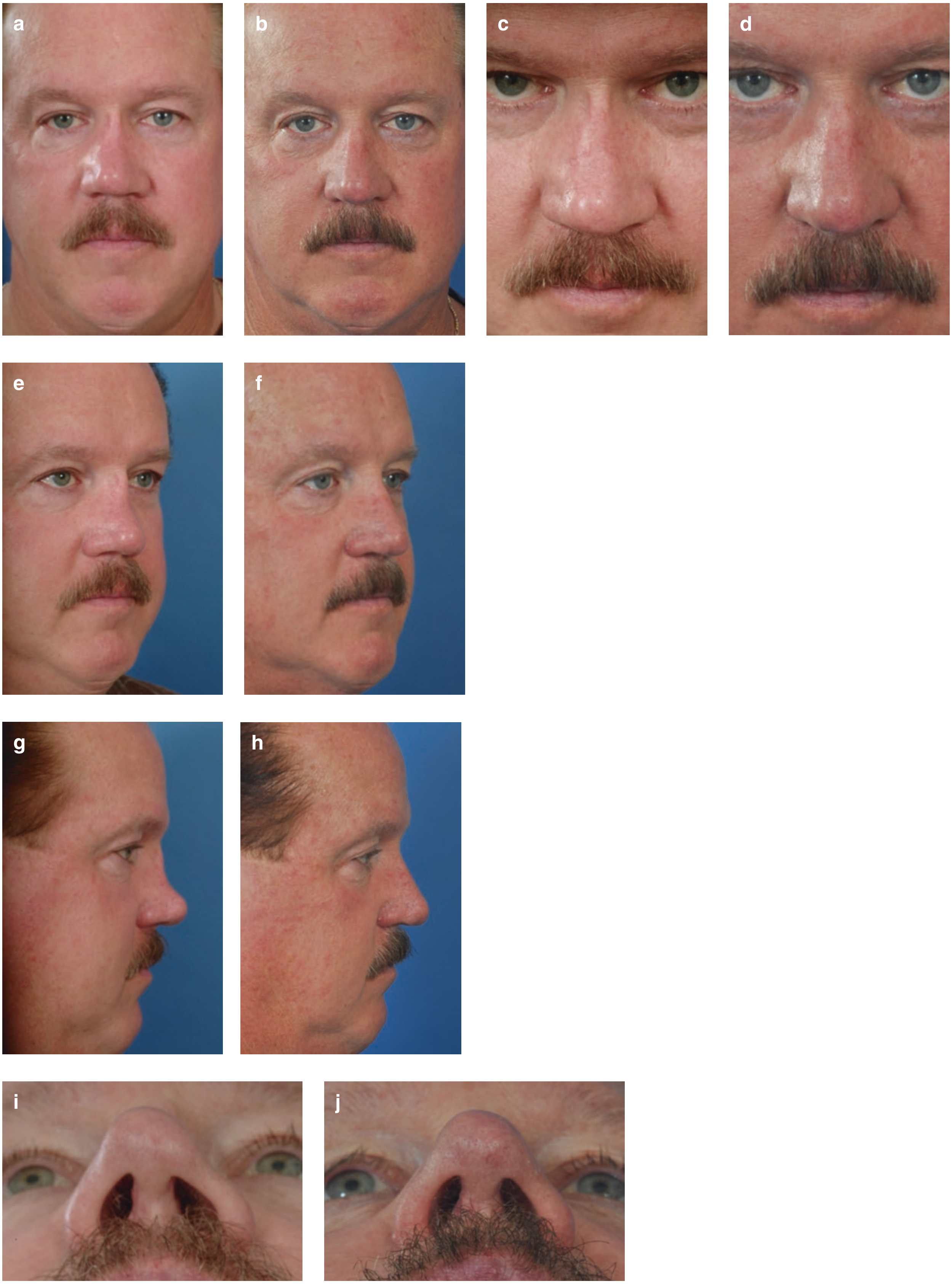


Fig. 6.32 (**a–j**) Patient before (*left*) and 3 years after (*right*) correction of nasal obstruction and deformity, Note: obliteration of NFr angle with solid rib graft versus normal NFr angle achieved with diced cartilage augmentation

DERMIS GRAFTS

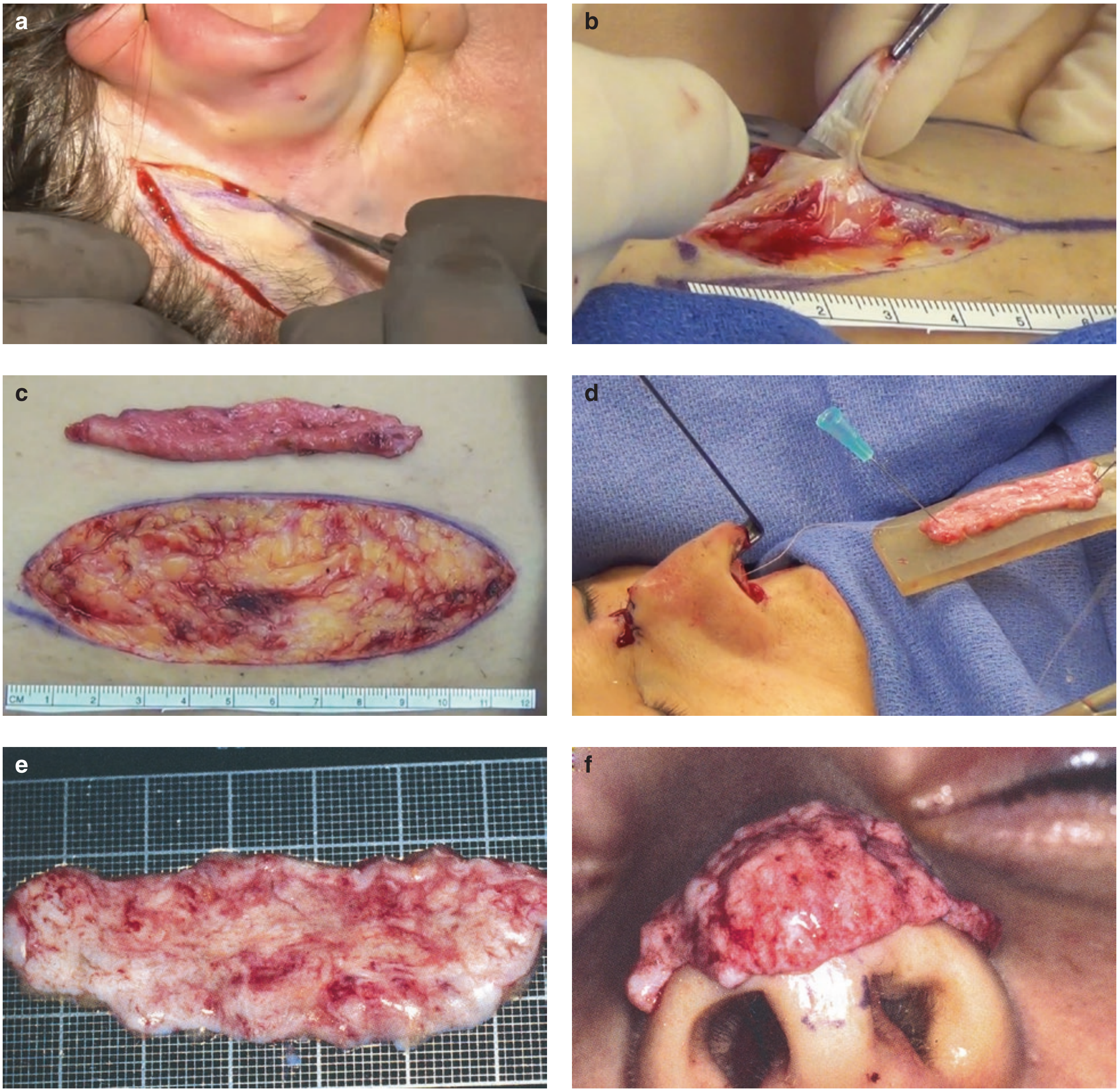


Fig. 6.33 Dermis grafts harvested from (**a**) retroauricular and (**b**, **c**) suprapubic areas. (**d**–**f**) Insertion of dermis grafts

Dermis grafts are harvested either from the retroauricular area for small (tip) amounts (Fig. 6.33a) or large (dorsum) amounts from the suprapubic region (Fig. 6.33b, c). The goal is to obtain a thick dermis with minimal subcutaneous fat. Therefore, the retroauricular harvest is made adjacent to the scalp, not from the back of the ear. It measures 8 × 2 cm. The area is deepithelialized and then the dermis is carefully elevated off the subcutaneous tissue. During the closure, it is essential to undermine the scalp for several centimeters posteriorly and then advance it forward, followed by fixation to the deep fascia. Then the skin is closed in layers without tension, which minimizes scar spreading. A similar technique is used to harvest dermis from the suprapubic region. The donor site is quite large (12 × 5 cm), as the graft contracts severely when it is removed. These grafts are inserted with the dermis placed upward against the skin envelope (Fig. 6.33d–f).

ALLODERM® GRAFTS

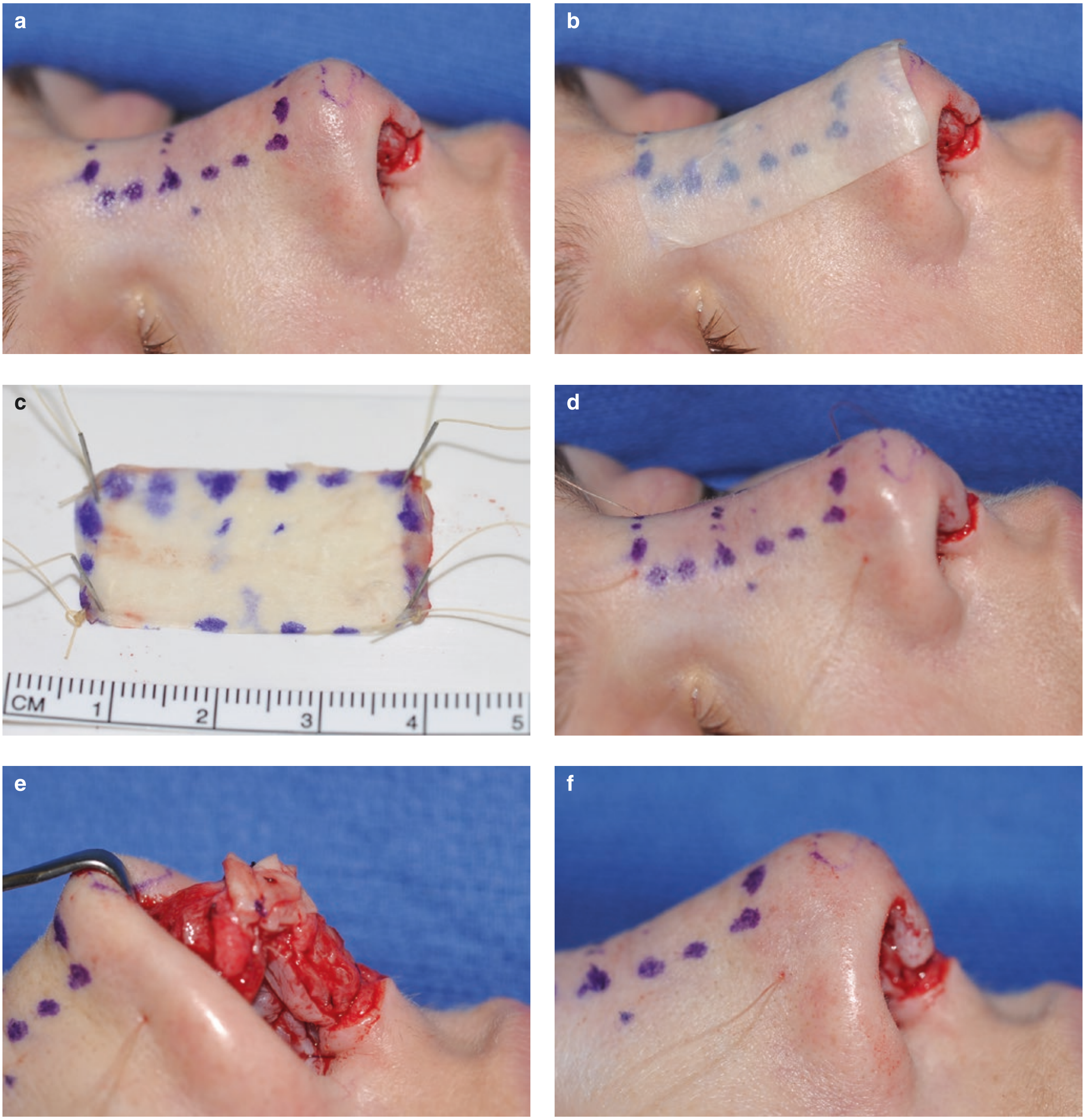


Fig. 6.34 Acellular dermal matrix (ADM): AlloDerm on the (**a–d**) dorsum and (**e–f**) tip

AlloDerm® regenerative tissue matrix is used reluctantly, as its survival is predicated in part on the vascularity of the recipient bed. Gryskiewicz et al. (2001) analyzed a series of cases of AlloDerm® grafts to the nose and found that the more scarred the skin envelope, the poorer the survival of the graft—that is, the greater the need, the less volume survived. We use AlloDerm® for padding of the dorsum and even the tip in rare, very selected secondary scarred noses (Fig. 6.34). Ideally, the etiology is thinning or destruction of the soft tissue layer beneath a thinned dermis; that is, we are restoring padding to the nose rather than salvaging the intrinsic skin.

DERMIS GRAFT (CASE STUDY)

Analysis: A 56-year-old woman of Filipino descent presented with a history of multiple nasal implant surgeries. The current exposure (Fig. 6.35a) had been present for over 9 years, following a steroid injection into the nose. The tip area was extraordinarily thin. Following extensive discussion with the patient and her family, a two-stage reconstruction was elected. Stage 1 would involve removal of the implant and immediate insertion of a dermis graft to repair the STE. Concomitantly, a rib graft would be harvested for a major columellar strut and tip graft to maximize expansion of the STE. Stage 2 would be done 6–9 months later, once the dorsal skin was healed.

Operative Technique:

1. The nose was opened, the implant removed, and cultures taken. Skin holes were closed with 6-0 nylon.
2. The ninth rib was harvested. A 12 × 3-cm elliptical area of dermis was harvested from the suprapubic region.
3. A columellar strut was inserted between the alars, which were advanced upward, and then a tip graft was added.
4. The dermis graft was placed onto the dorsum, with a second dermis graft over the tip.
5. Small alar rim grafts were added. Definitive composite grafts were not done owing to the risk of infection.

Commentary: This case was a total nightmare, with two contiguous areas of skin necrosis and an intervening skin bridge of questionable viability, with chronic bacterial contamination. Thus, the goal was to close the holes and achieve a healthy skin envelope before a second definitive reconstruction with dorsal augmentation and composite conchal rim grafts. At 2 years postop (Fig. 6.36), the patient is quite happy and has decided not to have the Stage 2 operation.

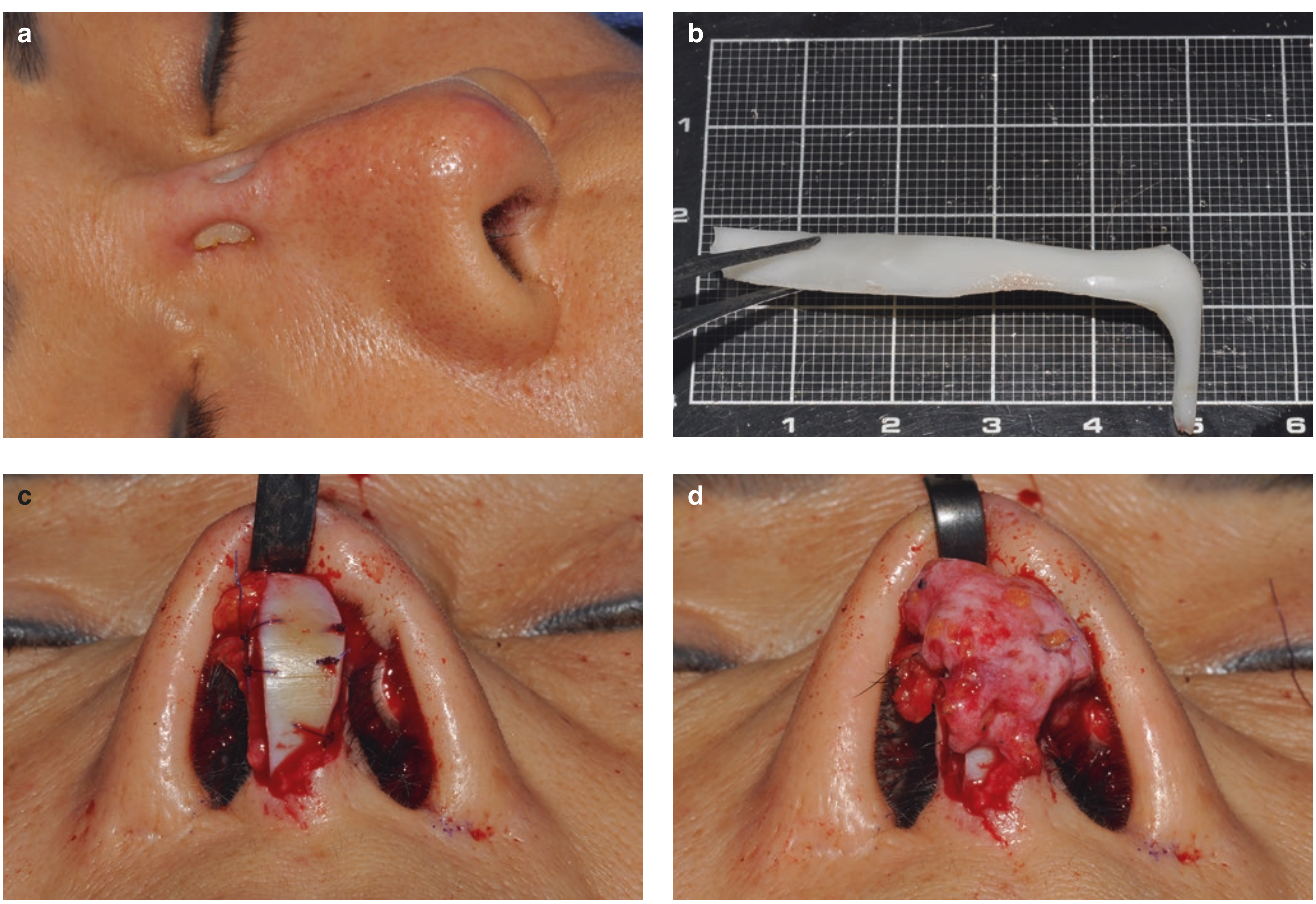


Fig. 6.35 (**a–d**) Silicone implant replacement

DERMIS GRAFT (CASE STUDY)

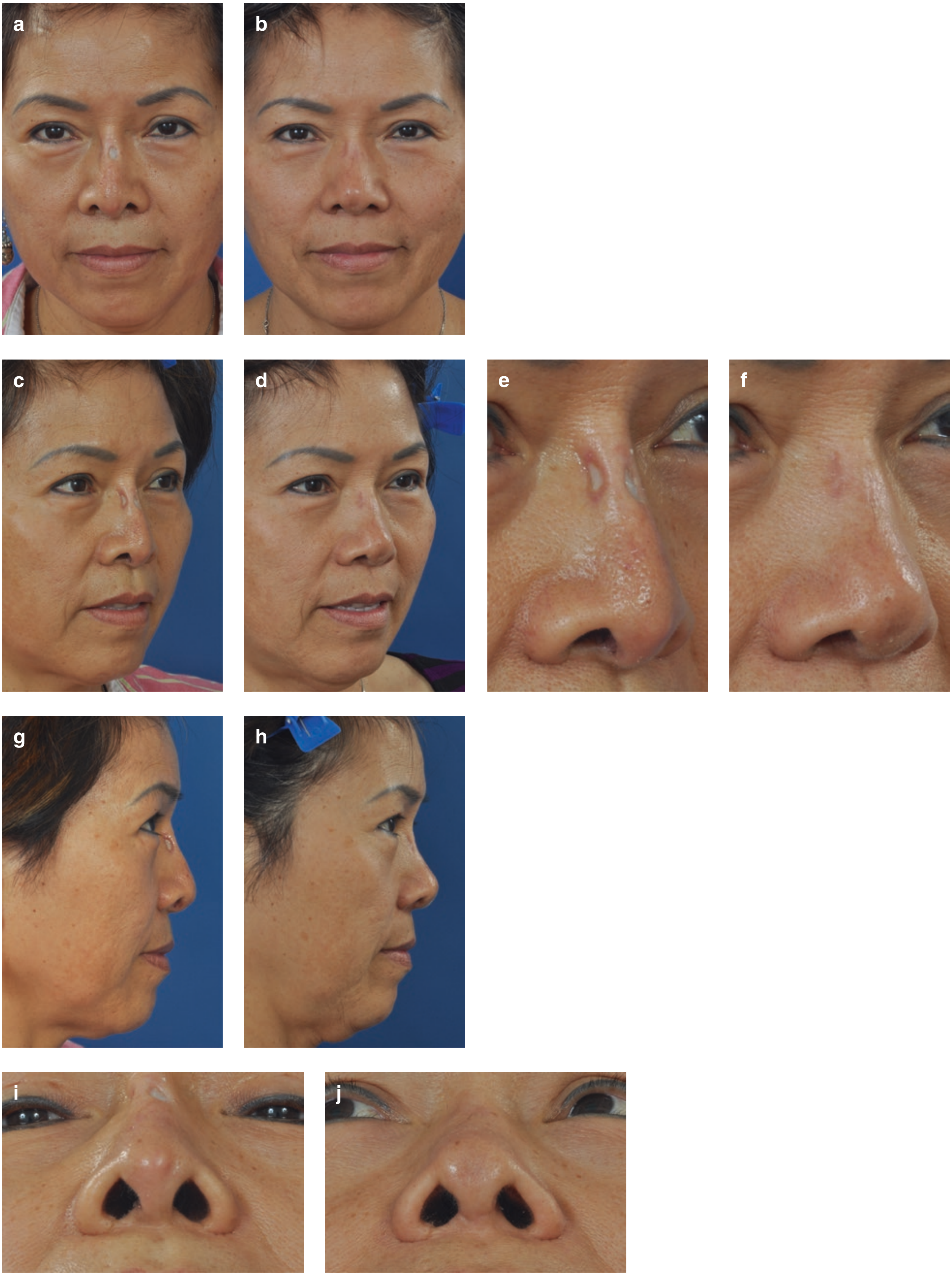


Fig. 6.36 (**a–j**) Patient before and 2 years after implant replacement and dermis grafts. Note: Patient was happy with initial salvage procedure and declined the planned Stage 2 aesthetic procedure

SUBTOTAL AND TOTAL SEPTAL REPLACEMENT GRAFTS

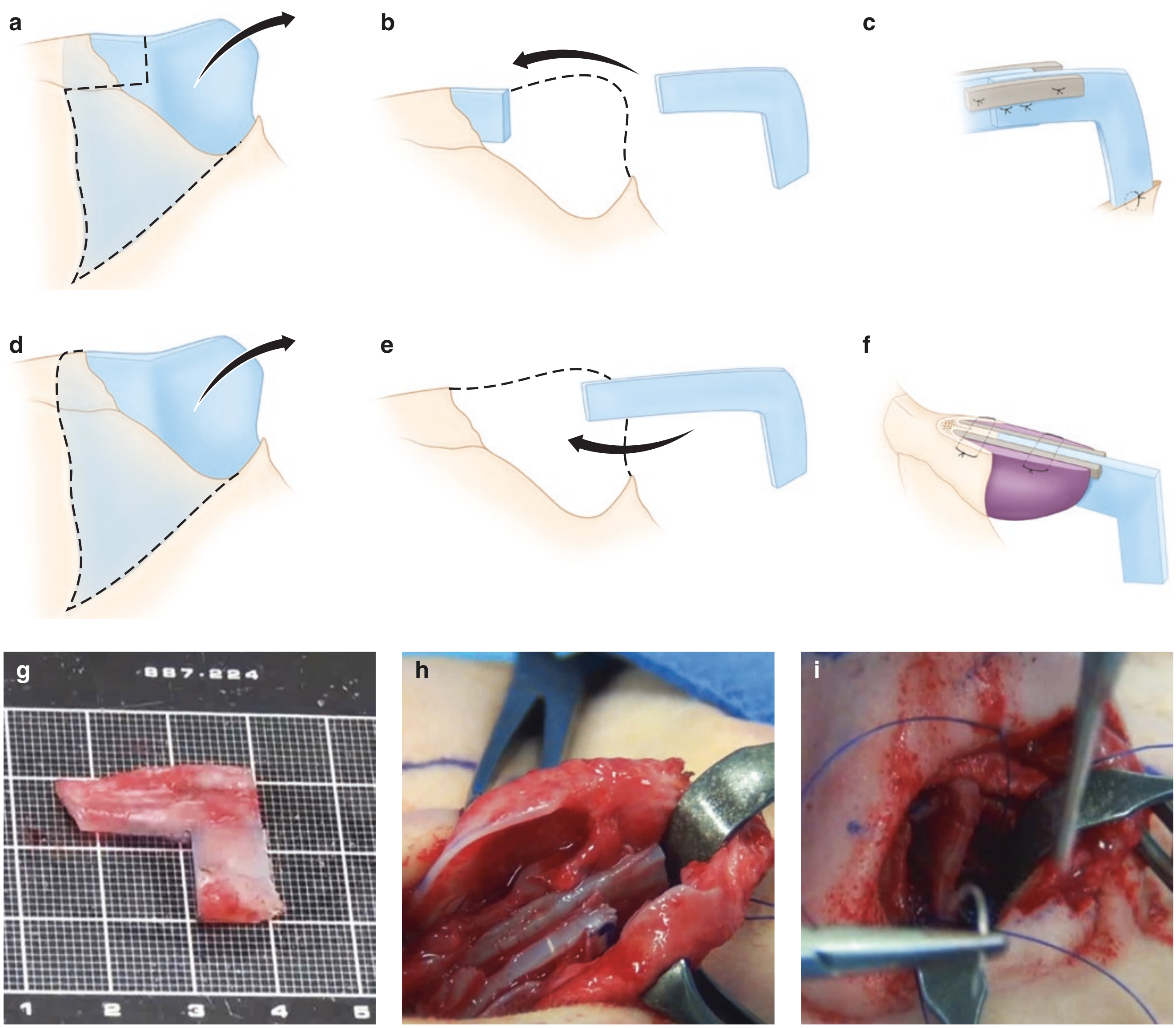


Fig. 6.37 (**a–c**) Subtotal septoplasty. (**d–f**) Total septoplasty. (**g–i**) Subtotal septal replacement graft

As one progresses to more complex secondary and aesthetic reconstructive rhinoplasties, it is essential to understand that the nose is being built upon a straight, stable septal foundation. Thus it is important to review the concept of subtotal and total septoplasty (Fig. 6.37). These operations were pioneered by Gubisch (2006, 2017) whose results from over 2500 cases confirm their efficacy. A ***total septoplasty*** implies complete removal of the *osseocartilaginous septum* and replacement with an L-shape strut, often with attached spreader grafts. Thus, the challenge is to obtain rigid fixation cephalically, which often requires drill holes through the nasal bones and some type of crushed cartilage graft to ensure a smooth keystone junction. In contrast, the ***subtotal septoplasty*** leaves a stump of midline dorsal septum and removes primarily the deviated septal cartilage. Thus, attachment of the L-shape strut is simpler, as one can suture the strut to the dorsal septal remnant with an overlap, thus minimizing the risk of dorsal disjunction and ensuring a smoother junction. In both cases, however, stability is critical, and one must become comfortable with taking out and replacing the septum.

SEPTAL RECONSTRUCTION GRAFTS

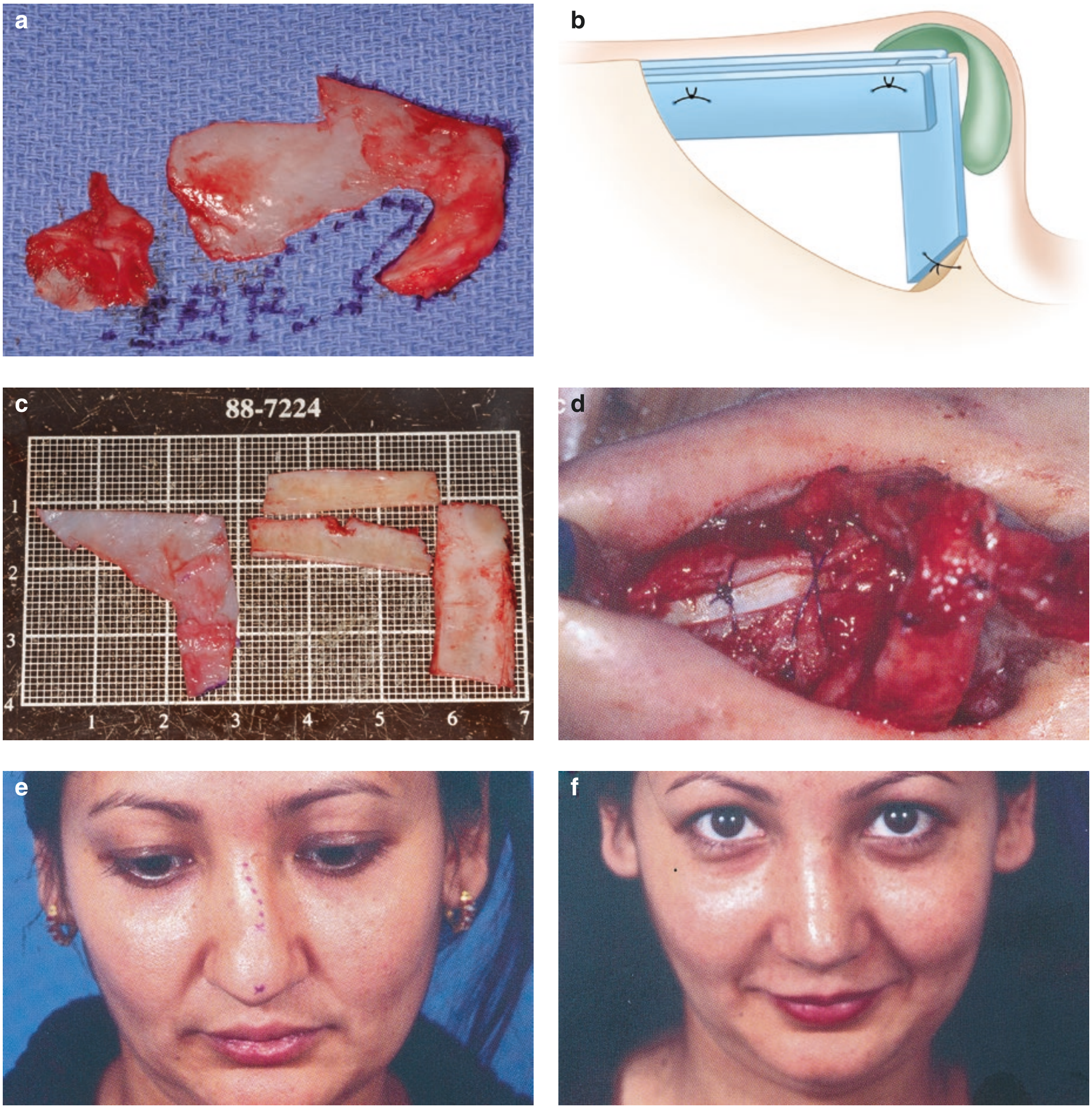


Fig. 6.38 (**a**–**f**) Septal reconstruction graft

In certain secondary or tertiary deformities, one opens the nose and finds that the septum is totally unstable and severely damaged. It cannot be converted into an L-shape strut. When one is doing a tertiary rhinoplasty, the septum may be completely absent, and total reconstruction is necessary. The goal is to restore a 10-mm L-shape strut using spreader grafts and a *septal strut*—that is, the equivalent of the vertical component of the normal L-shape septal strut. The graft often measures 18–20 mm vertically and is 10 mm wide. The ***septal strut*** is not a septal extension graft, nor are the alar cartilages sutured to it, Rather, a separate columellar strut is used to support the tip. In addition, the spreader grafts are of normal length and do not extend across the internal valve angle. Essentially, one restores structural stability to the nose by providing a deep foundation layer. Figure 6.38c illustrates a caudal septal replacement graft next to a set of spreader grafts and a septal strut made from rib cartilage. The patient as seen preop and 1 year postop in Fig. 6.38e, f, the patient had had two prior septoplasties; a large septal perforation mandated septal reconstruction to both support and straighten the nose.

COMPOSITE RECONSTRUCTION (FOUNDATION LAYER)

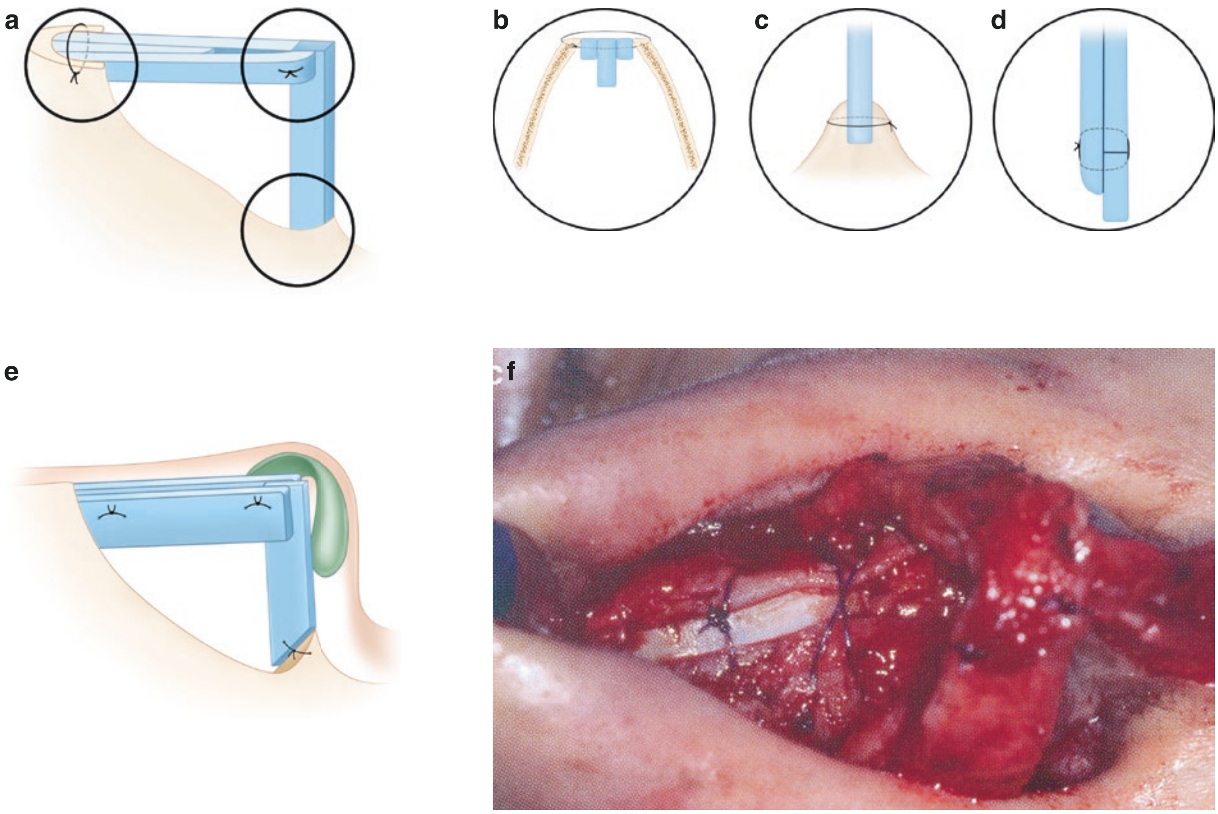


Fig. 6.39 (**a**–**f**) Composite reconstruction: foundation layer

Composite reconstruction is a two-component technique (Daniel and Brenner 2006; Daniel 2007). First, the deep *foundation layer* restores structural support previously provided by the L-shape septum, using spreader grafts and a true septal strut. Second, an overlying *aesthetic layer* is added to achieve tip refinement, using a columellar strut with alar advancement or a tip graft followed by dorsal contour using a DC-F graft. In most cases, autogenous rib is required, as the quantity of cartilage needed exceeds available septal material and the requisite rigidity precludes conchal cartilage. A two-layer reconstruction maximizes aesthetic finesse while minimizing the vagaries and warping of rib reconstructions.

The **deep foundation layer** ***is a replica of the L-shape septal strut.*** The spreader grafts replace the dorsal component, and a true septal strut replaces the vertical component (Fig. 6.39). The anterior nasal spine (ANS) is exposed through a gingival incision, and a drill hole is made through the ANS. If the ANS has been resected, then a central groove is made in the midline, and then drill holes through the pyriform lip on either side. A 4-0 PDS suture is passed through each drill hole for subsequent bidirectional fixation. Next, spreader grafts are placed high beneath the bony vault. It is important to avoid making the nose too wide. Once satisfied, the grafts are held in place with #25 needles and then multiple five-layer sutures of 4-0 PDS are inserted. On occasion, it may be necessary to place drill holes through the bony vault to fix the spreader grafts. Next, the alar cartilages are separated from top down and the precut *septal strut* is passed from the dorsum down to the groove in the ANS. Once the septal strut is seated, then the preplaced 4-0 PDS sutures are used to fit the strut rigidly to the ANS. It is important to realize that this is a **septal strut** and not a septal extension graft designed to influence the columella. They are not the same! The classic tongue-in-groove overlap of spreader grafts on either side of a strut is not used because it is too bulky and can block the internal valve angle. Rather, a "step off" configuration is used. One spreader graft is kept long as an overlap brace, and the other is cut shorter to act as a midline abutment against the strut. They are sutured together with 4-0 PDS. At this point, one has a rigid, L-shape septal replacement and foundation for the nose.

COMPOSITE RECONSTRUCTION (AESTHETIC LAYER)

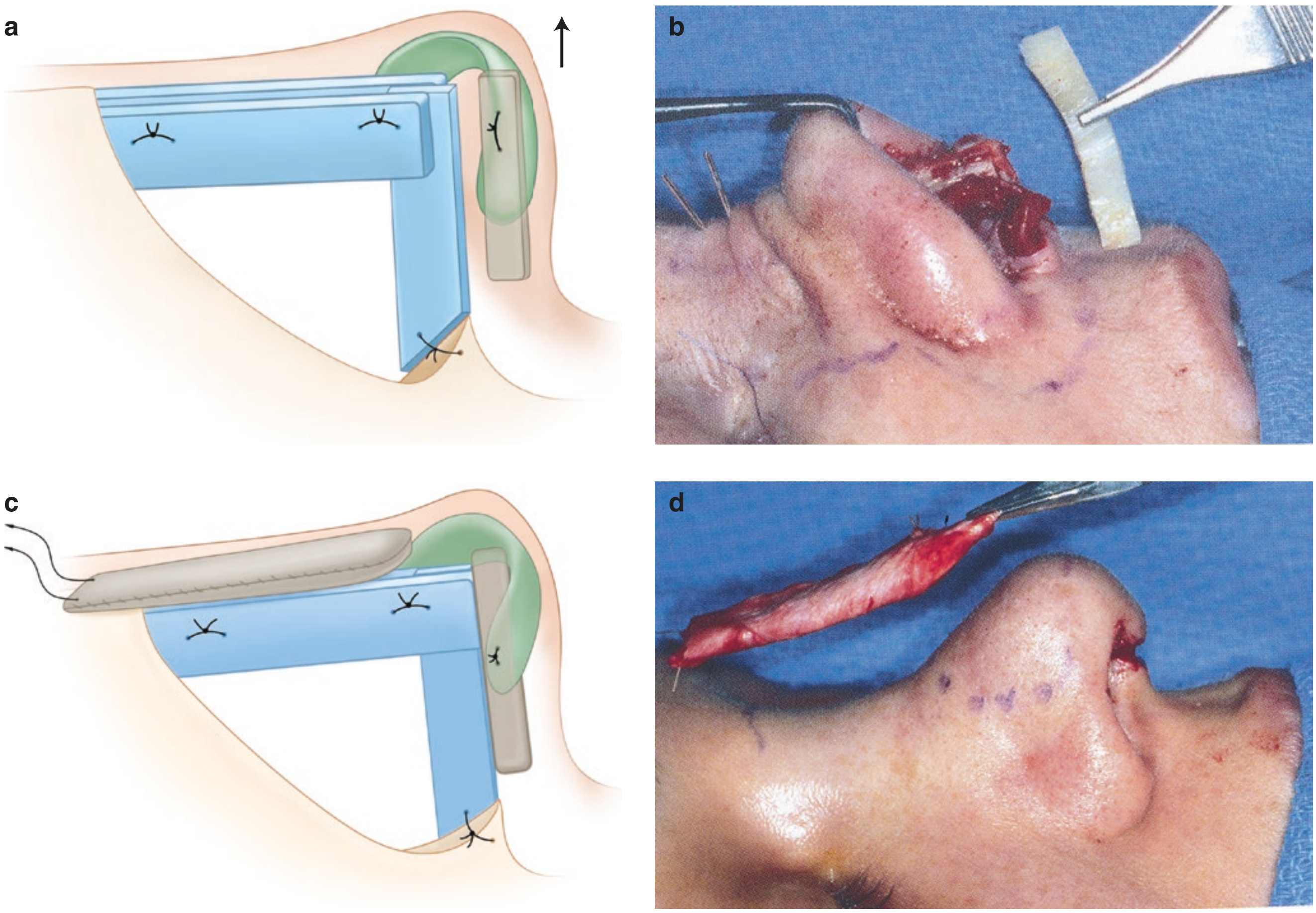
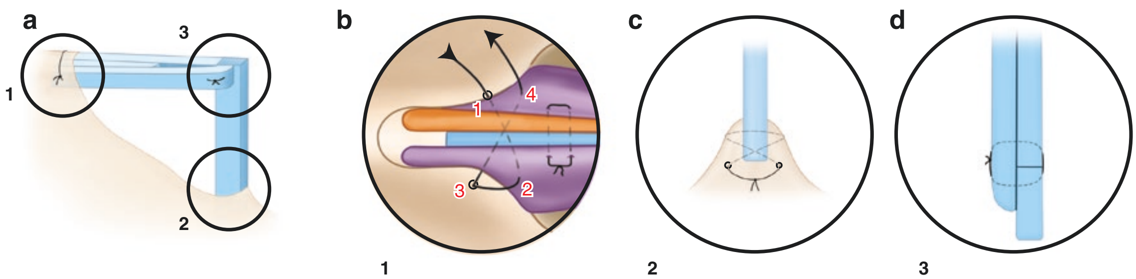


Fig. 6.40 (**a–d**) Composite reconstruction: aesthetic layer

The **aesthetic layer** begins with tip support and then dorsal contour. A standard columellar strut (25 × 3 mm) is inserted between the alar cartilages (Fig. 6.40). As usual, the alars are advanced upward, fixed with a #25 needle, and sutured with 5-0 PDS. Frequently, the alars will have been damaged and there will be a need for either add-on or structure tip grafts. Essentially, these maneuvers are the ones done in secondary cases. Once the tip is finalized, then a custom, "made to measure" DC-F dorsal graft is constructed on the back table. Variations in length, width, and thickness can be controlled. The graft is guided into place with cephalic percutaneous sutures and then sutured at the anterior septal angle. Frequently, the pyriform area is contracted and will require support using diced cartilage. Pockets are made beneath each alar base and onto the maxilla via a gingival incision. The DC is packed into the pockets and the incision is closed with 4-0 chromic. Fascial grafts and rib perichondrium are often used in patients with thin skin, but perichondrium should not be used indiscriminately throughout the nose, as it diminishes definition. It is useful for padding, whereas fascia is preferred for filling. Numerous small grafts are often necessary to achieve the desired definition throughout the nose, especially in the lobule, alar rims, and nostrils. However, the authors do not advocate the use of "cartilage paste" nor injections of ultrafine diced cartilage throughout the nose for augmentation or contour corrections. We do not think that the initial benefits will last long term.

STRUCTURAL RECONSTRUCTION



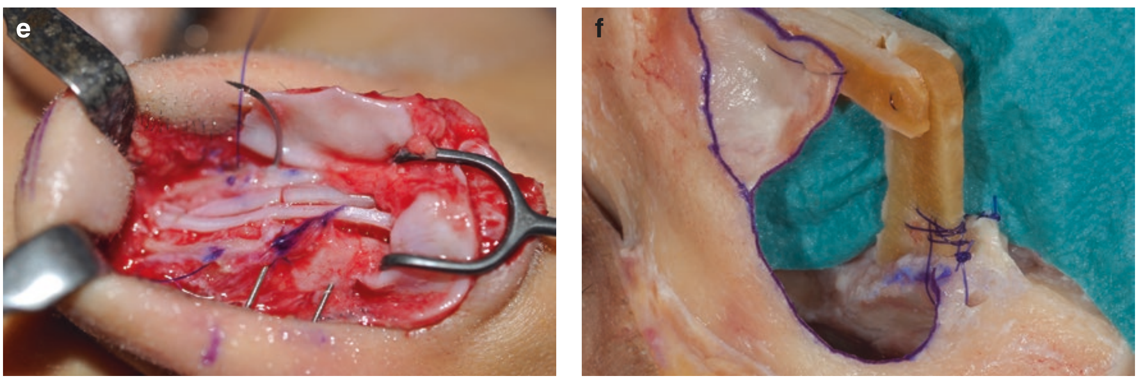


Fig. 6.41 (**a**–**f**) Structural reconstruction

The concept of ***composite reconstruction*** can be extended to ***structural reconstruction***. Essentially, the foundation layer is extended to provide a rigid framework on which to stretch the contracted skin framework. Wide SEG grafts are inserted, which extend from or replace the caudal septum and then cross the membranous septum before inserting into the soft tissue of the columella. The aesthetic layer is then added onto the structured layer. Often, these are not simple tip procedures, but rather complete reconstruction of the distal third of the nose from lateral crus to lateral wall, to alar base, to nostril.

To fully understand the entire concept of structural reconstruction and septal extension grafts, one must realize the progression from primary to secondary cases to full reconstructions. As previously noted, *columellar grafts* were first used to control unification and stability of the crura. Next, *caudal extension grafts* were introduced to modify the position of the columella relative to the nostril rims. Then *septal extension grafts* were introduced to stabilize tip position and projection. In dealing with the upwardly rotated or foreshortened nose, real challenges emerged, as these are rarely primary cases. Simple pennant grafts can be used in primary cases, but they are rarely structurally strong enough to overcome the forces of contracture in heavily scarred noses. The concept of structural reconstruction was pioneered by Gunter (1993), perfected by Toriumi (1995), and extended to the destroyed nose by Calvert et al. (2014). The surgeon does not have the luxury of separating the rebuilding into a foundation and an aesthetic layer, but rather must provide a rigid framework for expansion and stabilization against the forces of contraction. There is no normal anatomy. The alar cartilages are deformed or previously excised, the entire ligamentous structure (including the membranous septum) is scarred, and structural support is often absent. Once the bony vault has been corrected, including the requisite osteotomies, two holes are drilled through each nasal bone and the extender spreader grafts are sutured into the bony vault. Suturing is done either in a cerclage or criss-cross manner (Fig. 6.41b, c). The SEG is placed in the 10–15 mm–wide tripartite space between the caudal septum, membranous septum, and medial crura. These SEG grafts are often massive and are contoured in situ as regards their caudal and superior dimensions. Fixation of the SEG to the ANS is done with bidirectional sutures through drill holes (Fig. 6.41d, e). In general, the fixation sequence is as follows: (1) spreader grafts to bony vault; (2) SEG to ANS; and (3) tapered straddled fixation between the spreader grafts and SEG. Once the basic framework is established, then any lining restrictions are eliminated through scar excision and replacement with composite grafts as necessary. In severe cases, one must think of *lobular reconstruction* of the entire distal third of the nose rather than isolated tip refinement.

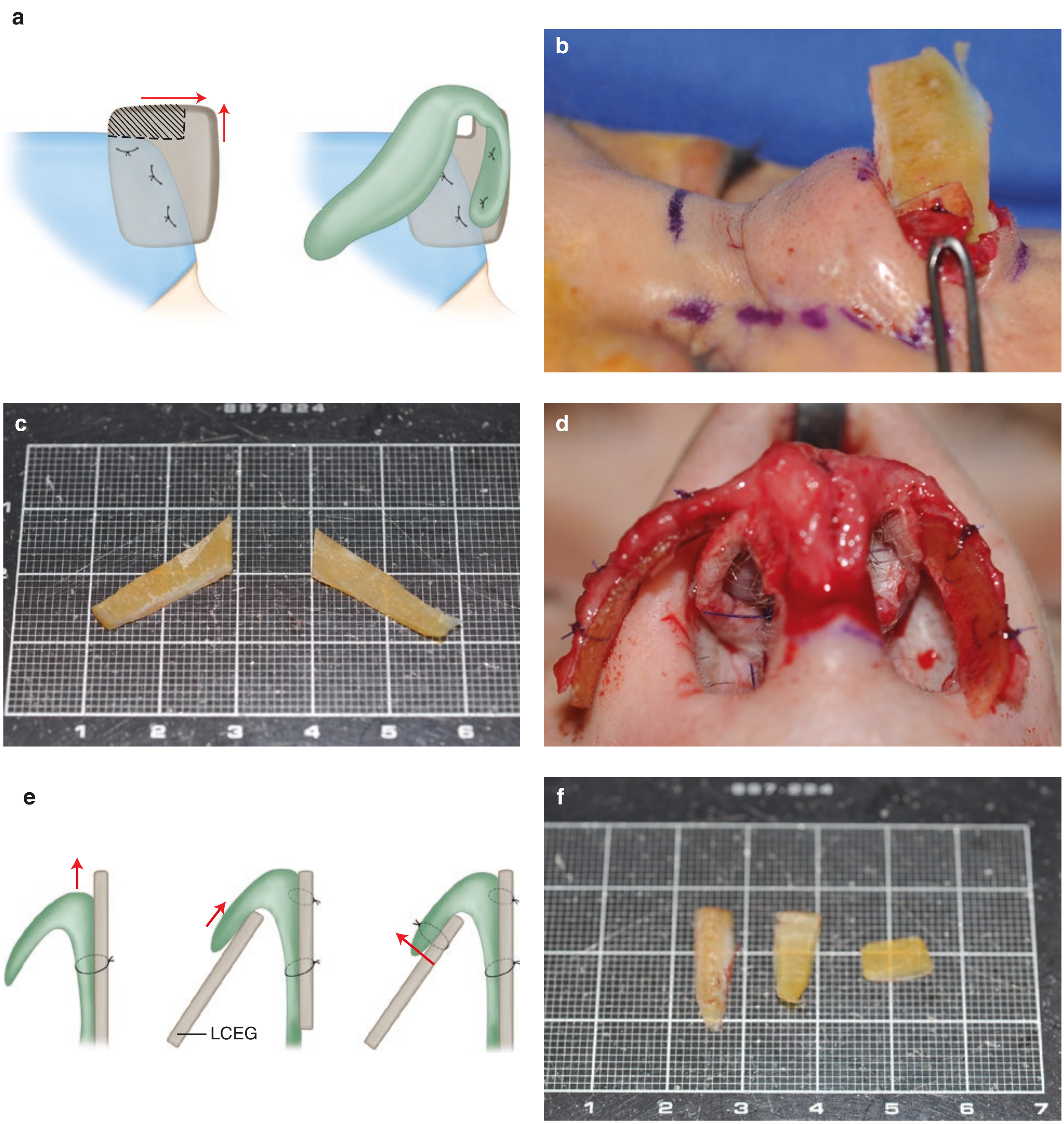


Fig. 6.42 (**a**, **b**) Septal extension graft (SEG). (**c**, **d**) Lateral crural strut grafts. (**e**, **f**) Crural advancement and tip grafts

During the initial tip time out, an inventory of the alar remnants is done. Obviously, if one can suture the alar remnants or do conventional open structure tip grafts, that would be the first choice. Unfortunately, this approach is often impossible, and one begins with suturing the remaining alar remnants to the strut beginning at the medial crus and advancing from medial to lateral. The desired tip projection is determined. Then the lateral stability of the lobule is restored with either lateral crural strut grafts or lateral crural extender grafts (Fig. 6.42). These are large (20 × 6 mm), thin (1–2 mm), rigid strips of rib cartilage design to support the skin envelope. Medially, the lateral crural extender grafts are sutured under any alar remnant while being placed into the alar base laterally. At this point in the operation, one can now begin placing the aesthetic layer of the reconstruction (DC-F, tip grafts, alar rim grafts, etc.). Frequently, composite conchal grafts are inserted into the nostrils to replace scarred lining.

STRUCTURAL RECONSTRUCTION (CASE STUDY)

Analysis: A 55-year-old woman of Vietnamese descent presented for reconstruction of her deformed nose. She had had three previous operations, including ear cartilage harvest and removal of a silicone implant 1 year previously. From a surgical perspective, the challenge would be to lengthen the nose, create a tip, and improve the nostrils, if possible (Fig. 6.43). Rib grafts would be essential to maintain length in this contracted nose.

Operative Technique:

1. Harvest of eighth and ninth rib using piezoelectric saws. Harvest of a composite partial conchal bowl with skin graft closure.
2. Open approach in subdermal plane followed by scar tissue excision. Gore-Tex® dorsal graft removed (Fig. 6.43c).
3. Extended spreader graft and major septal extension graft (SEG) sutured in place.
4. Alar cartilages advanced onto SEG. Double-level tip graft sutured in place, followed by a DC/AlloDerm® tip graft.
5. Minimal temporal fascia harvest on one side as prior harvest, and comparable scar on the opposite side.
6. An AlloDerm® sleeve was created (DC-A). A reversed, tapered DC-A graft was inserted (7 mm thick).
7. Insertion of major composite grafts (15 × 5 mm) into the apex of each nostril.

Commentary: These cases must be approached carefully and represent *aesthetic reconstructive rhinoplasty*. The alternative of a subtle closed augmentation procedure would have been minimally effective because of the thick, contracted skin sleeve. One must totally mobilize the skin and create a rigid structure to overcome the forces of contracture. The cushion DC-A graft placed over the tip graft everted the skin depression that followed the prior silicone implant. The composite conchal grafts recreated more natural nostril apices (Fig. 6.44).

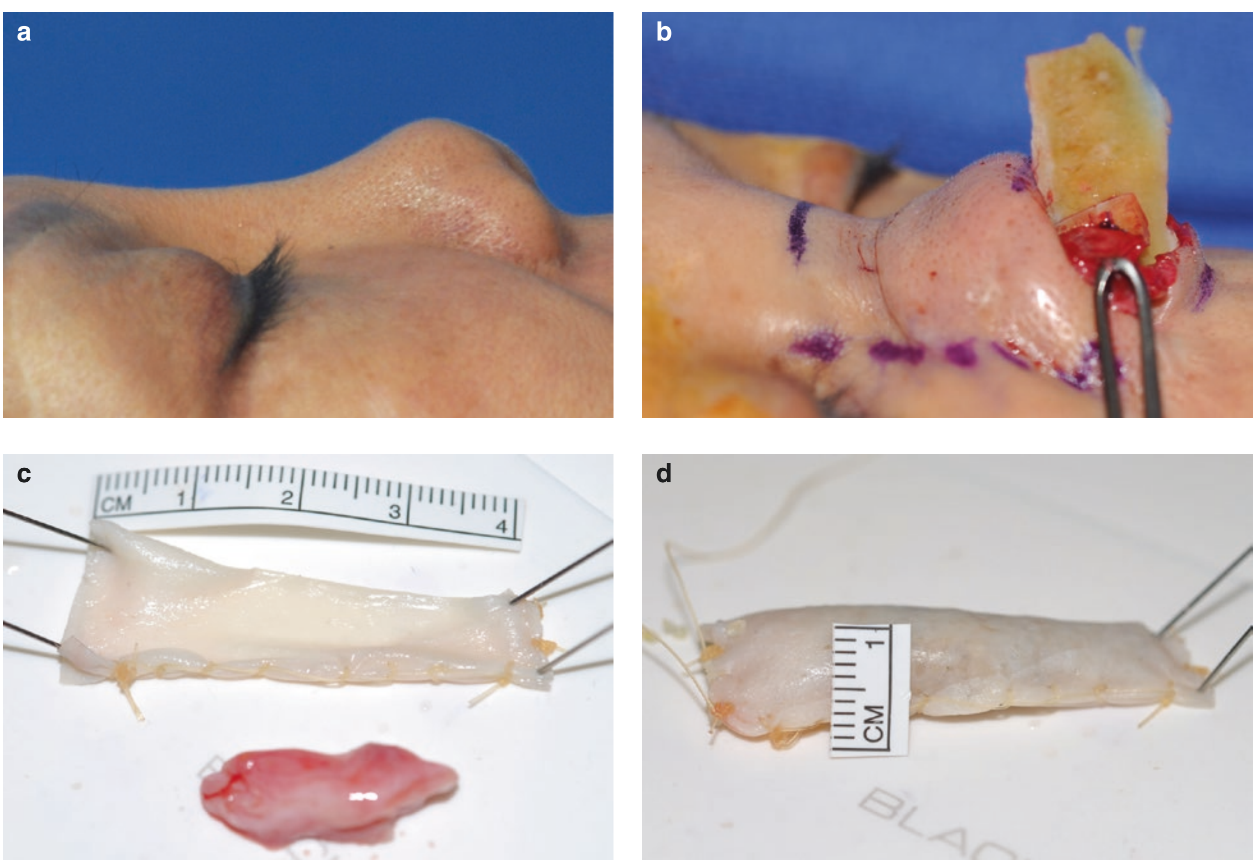


Fig. 6.43 (**a–d**) Structural reconstruction

STRUCTURAL RECONSTRUCTION (CASE STUDY)

Fig. 6.44 (**a–h**) Patient before (*left*) and after (*right*) aesthetic reconstructive rhinoplasty

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7 A Standard Rhinoplasty Operation

The technique in this chapter is offered as an expandable, sequential operation that can be easily modified to fit a wide range of primary noses. It is my firm belief that most well-trained surgeons with a passion for rhinoplasty surgery can do 80% of primary noses. Unfortunately, 95% of rhinoplasty lectures and articles deal with the most esoteric 5% of deformities, and there is often very little discussion of how to perform and modify a basic operation. I also believe that surgeons should operate within their comfort zone and sphere of competency. It makes no sense for surgeons with the least experience to do the most demanding cases. Remember, one good result brings you three cases but one bad case loses you nine, and in the Internet era, one disaster can ruin your career. Start with cases in which you know you will get a good result and expand your patient base over time. How do you teach yourself surgical cause and effect for your technique? You must keep detailed records and intraoperative photographs of your cases, write down your concerns, and see patients frequently. The reader is encouraged to use this standard operation as a template, but to review the pertinent sections of this text.

OPERATIVE ANALYSIS AND PLANNING

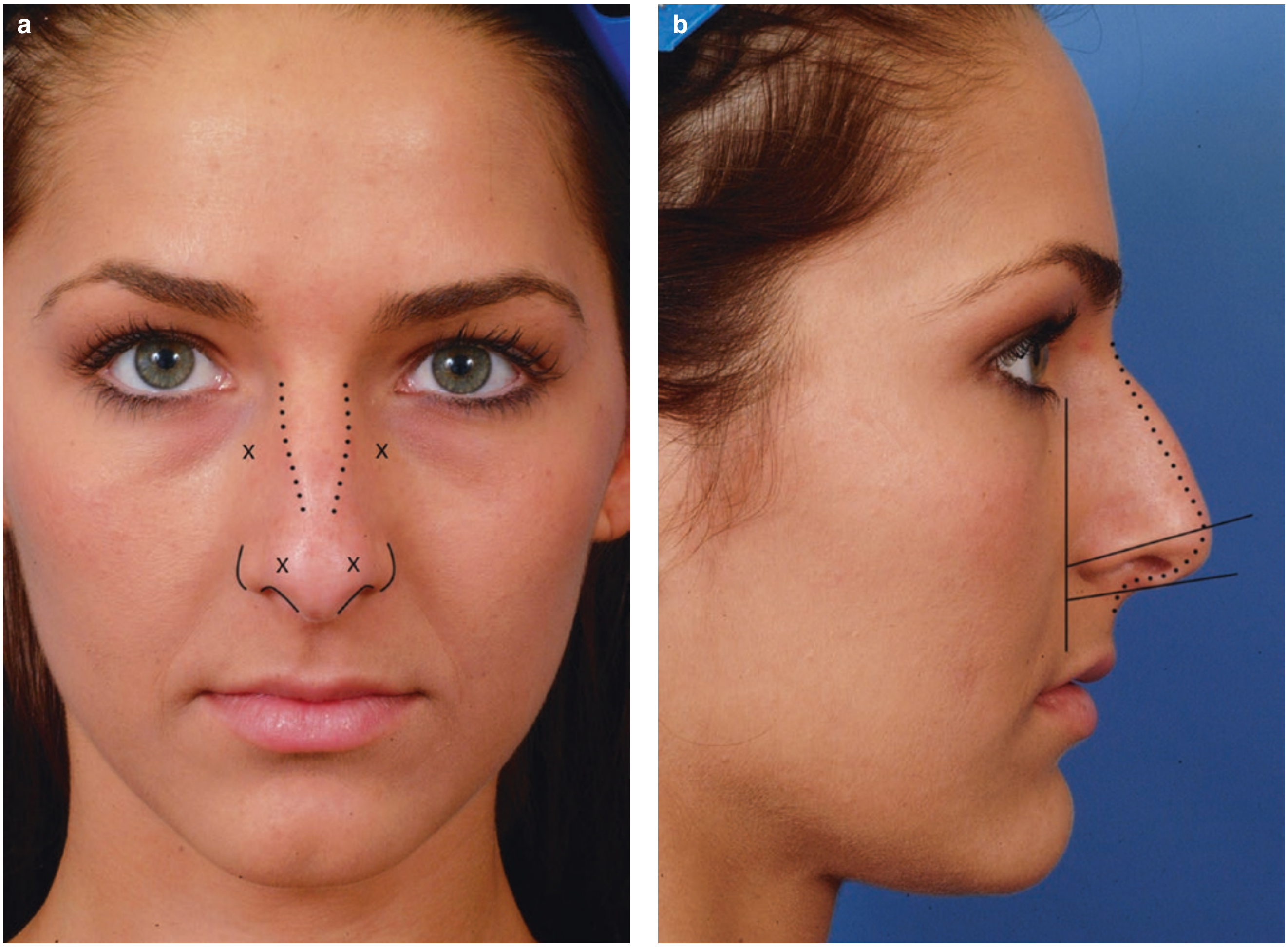

Fig. 7.1 (**a, b**) Operative analysis and planning

A rhinoplasty will be successful only if it achieves what the patient wants. Therefore, you must have patients point out in the mirror what three things bother them the most. Write these down on the operative planning sheet. Most women want a smaller, more feminine nose with a lower profile, narrower width, and a more refined tip (Fig. 7.1). Next, it is your turn to examine the nose externally and internally. Decide what the negatives are and what can be achieved realistically, given the patient's anatomy. Sketch out a proposed operative plan—how much reduction, what type of osteotomies and tip surgery, any base modification, and functional factors. The importance of the intranasal exam cannot be overemphasized. Assess the level of difficulty and whether this case fits within your comfort zone. After talking with the patient, determine whether you want this patient in your practice. If you both want to proceed, standard nasal photos of the patient are taken. The patient is asked to bring photos of noses he or she likes to the next appointment. Photographic analysis, with emphasis on the tip angle and tip projection, is important, and subtle differences in nostrils are evident on basilar view. The advantage of spending the time to write out a detailed, step-by-step operative plan is that the vast majority of operations go according to plan. You can concentrate on surgical execution and efficiency rather than on surgical decision-making. Yes, slight changes (add-on graft, alar rim graft) may be necessary based on actual anatomy, but you will not be staring at the nose, wondering what to do next (Table 7.1).

OPERATIVE ANALYSIS AND PLANNING

1.	Essentials: 2.5 × loupes, fiberoptic headlight, own instruments
2.	Anesthesia: General with appropriate monitors
3.	Local injection followed by preparation. Wait 10–15 min
4.	Removal of intranasal pack and shaving of vibrissae
5.	Open approach using infralobular and transcolumellar incisions
6.	Elevation of skin envelope
7.	Septal exposure via transfixion incision and extramucosal tunnels
8.	Reassessment of operative plan based on alar and septal anatomy
9.	Creation of symmetrical alar rim strips
10.	Incremental hump reduction, using rasp for bone and scissors for cartilage
11.	Caudal septum/anterior nasal spine excision (optional)
12.	Septal harvest/septoplasty
13.	Osteotomies
14.	Graft preparation
15.	Spreader grafts (optional)
16.	Columellar strut and suture
17.	Tip sutures with optional add-on grafts (excised alar cartilage)
18.	Closure
19.	Alar base modification (optional)
20.	Alar rim grafts or alar rim structure grafts (optional)
21.	Doyle splints, external cast, and nasal block

Table 7.1 A basic rhinoplasty sequence

Table 7.1 lists the steps in a basic rhinoplasty sequence. What are the most common variations in this sequence?

- *Step #11:* The caudal septum is altered in less than 30% of cases and the anterior nasal spine (ANS) in less than 5%.
- *Step #12:* Over 90% of septal problems in cosmetic cases are deviations of the septal body or caudal septum. A septal harvest often corrects the septal body, whereas a relocation fixes the caudal septum.
- *Step #13:* Osteotomies are not done in 10% of cases, in which the bony vault is quite narrow preoperatively, thus avoiding nasal airway reduction.
- *Step #15:* Spreader flaps remain the first option for closing the middle vault. Most spreader grafts are asymmetric, and 50% are inserted for aesthetic reasons.
- *Step #17:* Tip sutures are sufficient in 85% of patients; 15% will require add-on grafts of excised alar cartilage. A true tip graft of septal cartilage is used in less than 5% of Caucasian patients, but 95% of Asian and African-American patients.

It is wise to take a four-view set of photos of the exposed finished tip before closing. At the end of the operation, a detailed operative diagram is made, which records every step and any questions you might have as to surgical cause and effect.

ANESTHESIA AND SURGICAL INSTRUMENTS

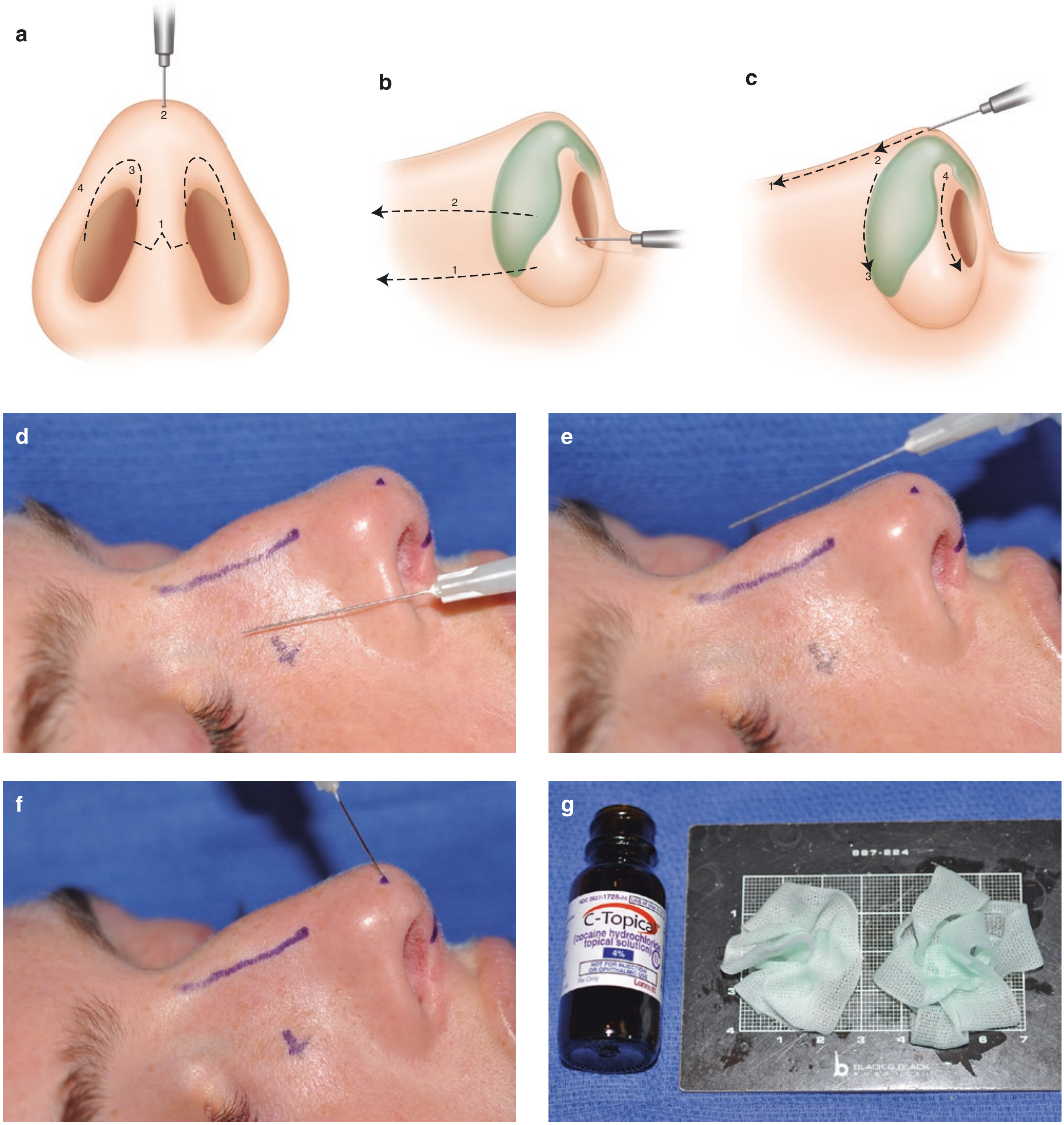

Fig. 7.2 (**a–g**) Local anesthesia and vasoconstriction

Once general intubation is complete, the external and internal areas of the nose are thoroughly scrubbed with Betadine paint. Then the local anesthesia with its vasoconstrictive agent (1% xylocaine with epinephrine 1:100,000) is injected (Fig. 7.2). The injections are done in two components: a picture-frame block to reduce the regional blood supply, and then injections to the specific areas of surgery. This method also produces an effective sensory block. Specifically, the five areas for injection consist of (1) tip and columella, (2) lateral wall, (3) dorsum/extramucosal tunnels, (4) incision lines, and (5) septum. First, the needle is inserted from the vestibule towards the infraorbital foramen, with injection occurring on withdrawal. Three sites are injected: the infraorbital foramen (infraorbital vessels), the lateral nasofacial groove (lateral facial vessels), and the alar base (angular vessels). The columellar base is injected extending outward below the nostril sills (columellar vessels).

ANESTHESIA AND SURGICAL INSTRUMENTS

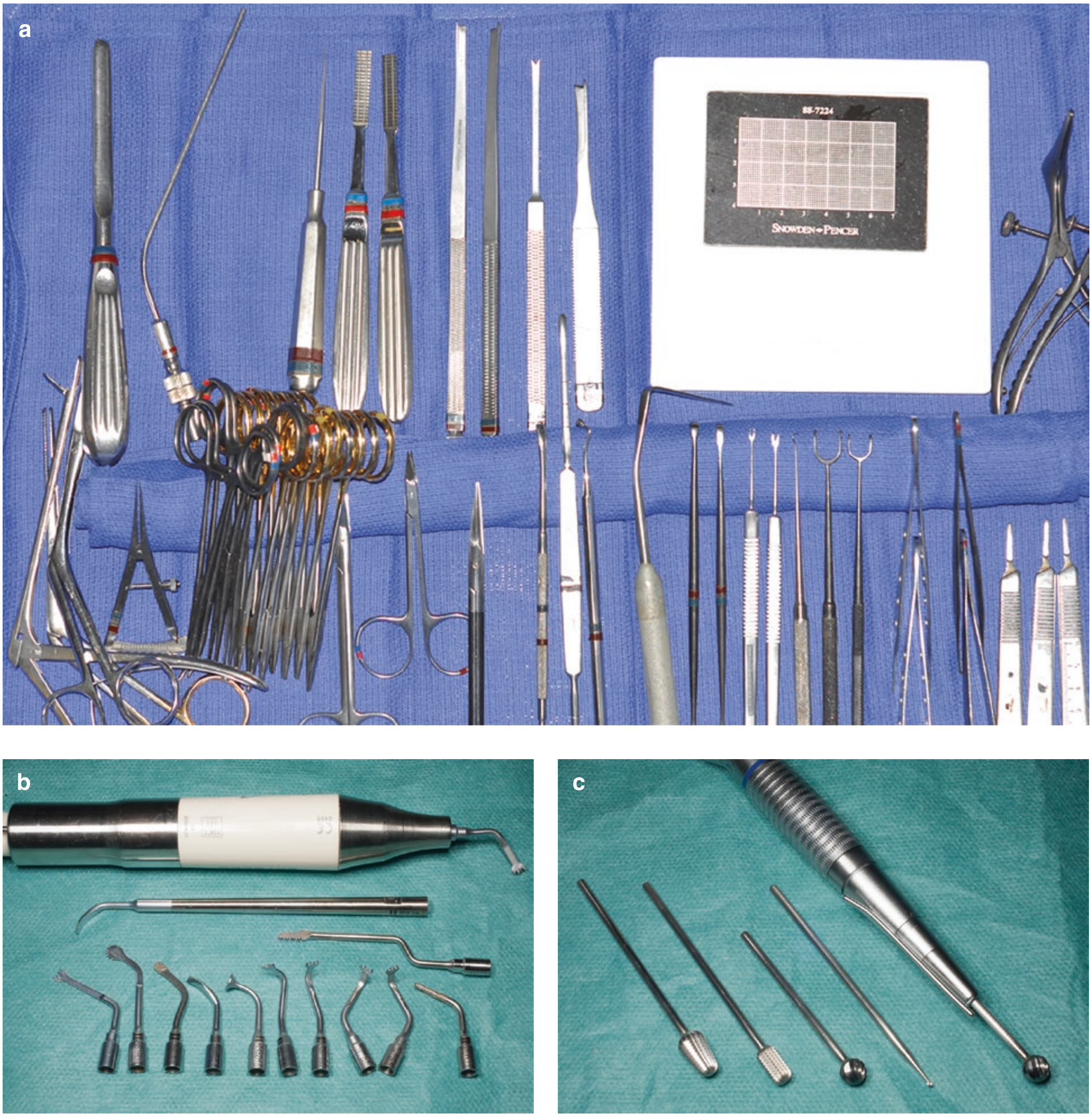

Fig. 7.3 (**a**) Standard surgical instruments. (**b**) Piezoelectric instruments, (**c**) Power-assisted burrs

The needle is then inserted along the top of the septum in the area of the extramucosal tunnels (anterior ethmoidal vessels). On withdrawal, the needle passes along the dorsum to facilitate future dissection and terminates in the radix area on either side (infratrochlear vessels). Next, the access incisions are injected with minute amounts of local anesthesia. The septum is blocked from posterior to anterior. For an open approach, one routinely injects 1–2 cc into the lobular skin envelope over the alar cartilages from the tip, extending laterally and down the columella. The nasal vibrissae are trimmed. The internal nose is packed with 18-inch strips of half-inch gauze wetted with 4 ccs of one of three solutions: 4% cocaine, 1% xylocaine with epinephrine 1:100,000, or Afrin. At this point, the surgeon goes and scrubs while the formal prep and drape are done, which affords 10 min for the local anesthesia to work.

The choice of surgical instruments (Fig. 7.3) is obviously surgeon-dependent. Loupe magnification (2.5–3.3×) and an LED headlight are essential.

EXPOSURE AND DISSECTION PLANES

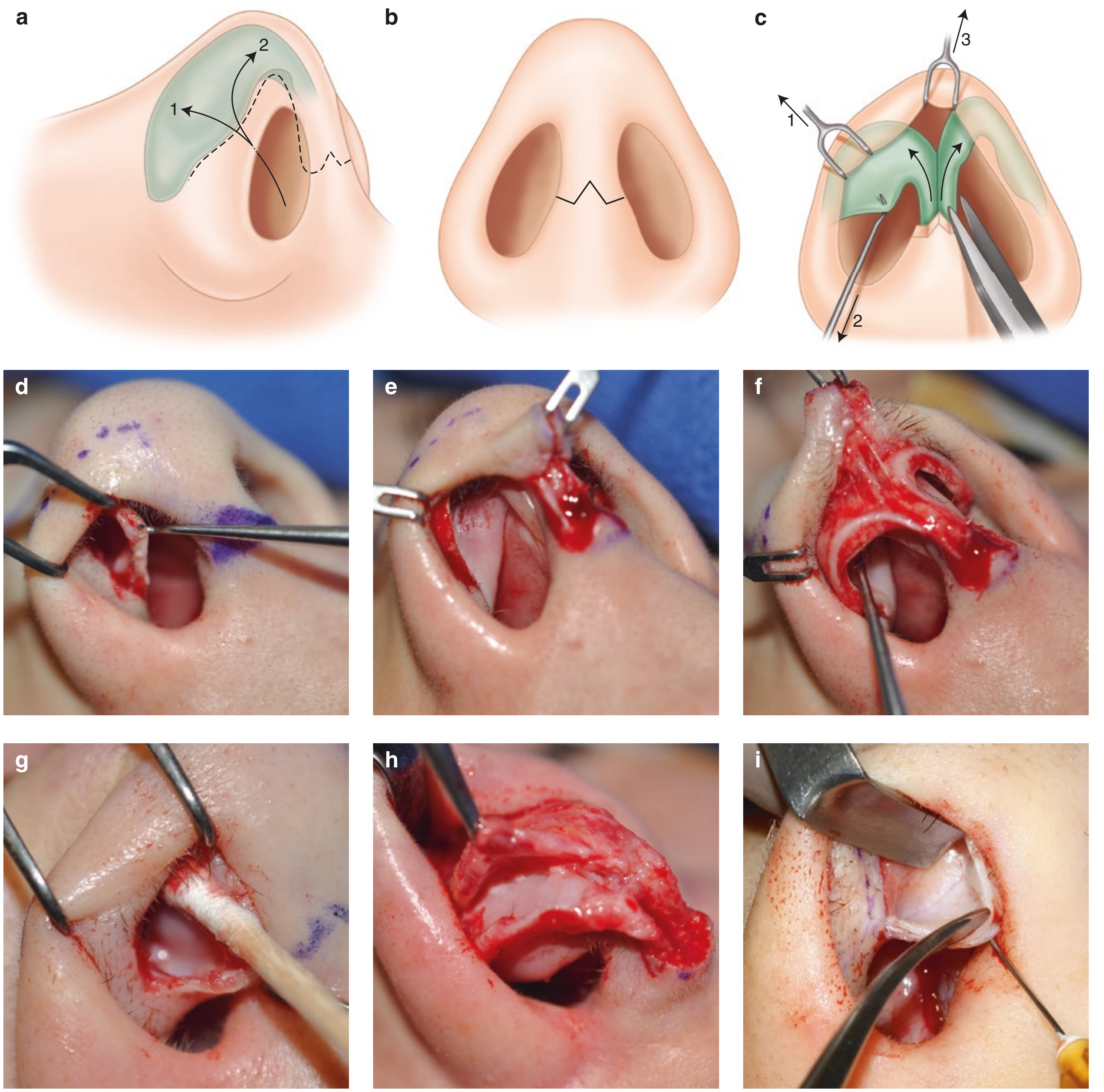

Fig. 7.4 (**a**) Initial infracartilaginous incision and dissection. (**b**, **c**) Columella-to-tip exposure. (**d–f**) Bidirectional exposure and the "three-point traction." (**g**) Standard sub-SMAS dissection plane. (**h**) Subdermal plane. (**i**) Subperichondrial dissection plane

Our preferences of incisions for performing an open approach are as follows. The transcolumellar incision should be an inverted-V and located at the narrow waist of the columellar. The lateral incisions should follow the caudal border of the lateral crus. In the majority of cases, we dissect in the sub-SMAS (superficial muscular aponeurotic system) plane in direct contact with the lateral crus, beginning from lateral to medial. Then the transcolumellar incison is made, with a dissection upward on the medial crura. At this point, the assistant pulls the dome downward and the "three-point traction" allows for safe exposure of the domal notch area (Fig. 7.4c). In patients with a thick soft tissue envelope (STE), a subdermal dissection plane is done, which leaves significant soft tissue on the surface of the the alar cartilages. Once exposed, the tissue is excised by dissecting in the deeper sub-SMAS plane. Only in patients with an extremely thin STE is a true subperichondrial dissection plane utilized.

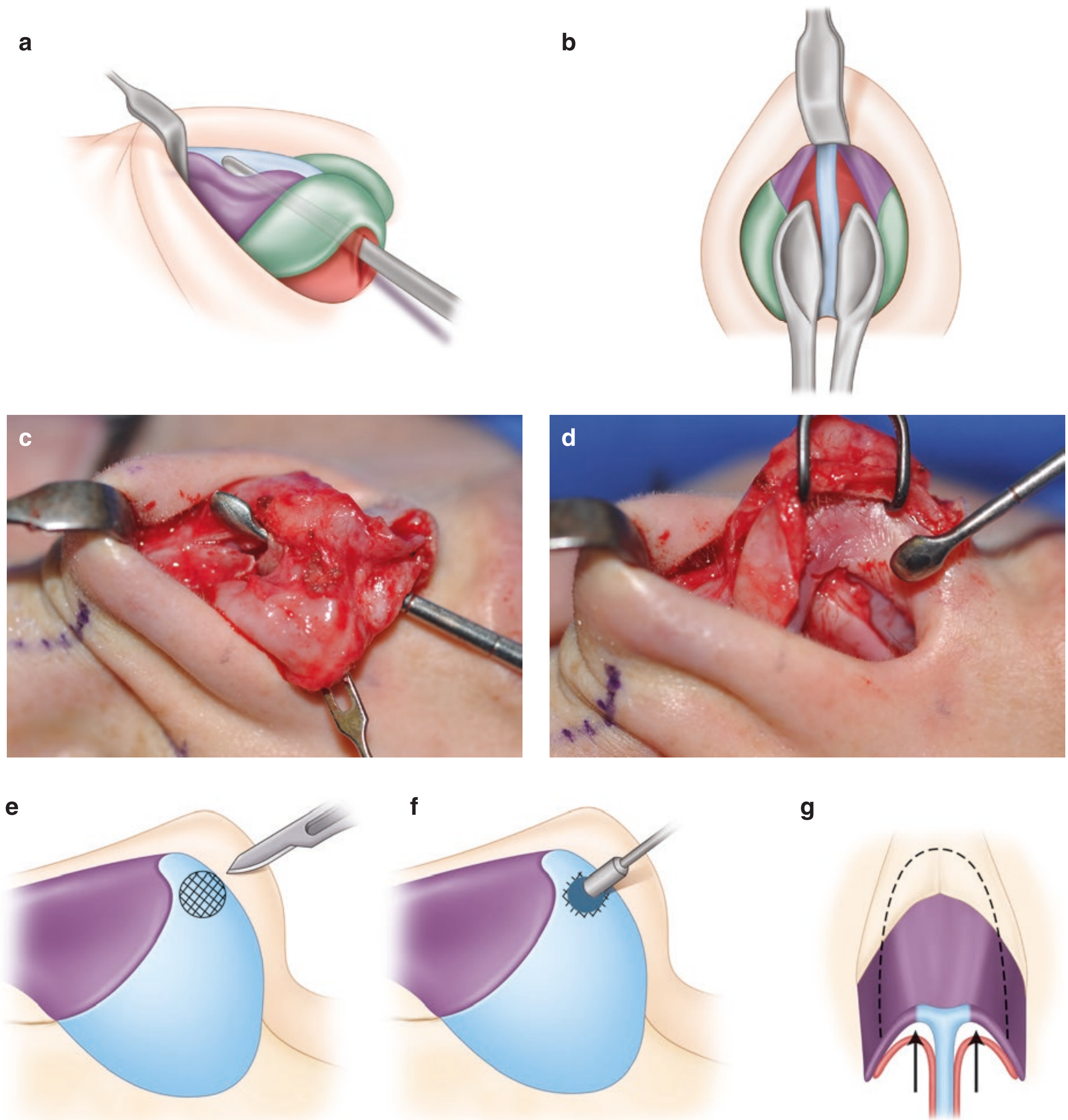

Fig. 7.5 (**a–d**) Septal exposure. (**e–g**) Extramucosal tunnels

There are two basic methods of septal exposure: the classic transfixion approach and the top-down bidirectional approach (Fig. 7.5). In the ***transfixion approach***, a vertical, full-length transfixion incision is made 2–3 mm back from the caudal border on the right side. Using the angled Converse scissors, the mucosa is elevated and the perichondrium is cross-hatched with a #15 blade and then scraped through to the cartilage, using the dental amalgam. Once the perichondrium is elevated, the dissection continues posteriorly over the cartilage and onto the ethmoid and vomer bones using a Cottle elevator. The ***top-down bidirectional approach*** begins *w*ith downward traction on the alar cartilages, which exposes the anterior septal angle area and allows easy elevation of the septal mucosa. Additional exposure can be gained by splitting the upper lateral cartilages (ULCs) off the cartilaginous dorsum or splitting the alar cartilages in the midline. Which dissection method is preferred? The surgeon can use either one or both. We prefer to start with a transfixion incision and then split off the ULCs via the extramucosal tunnels.

TIP ANALYSIS

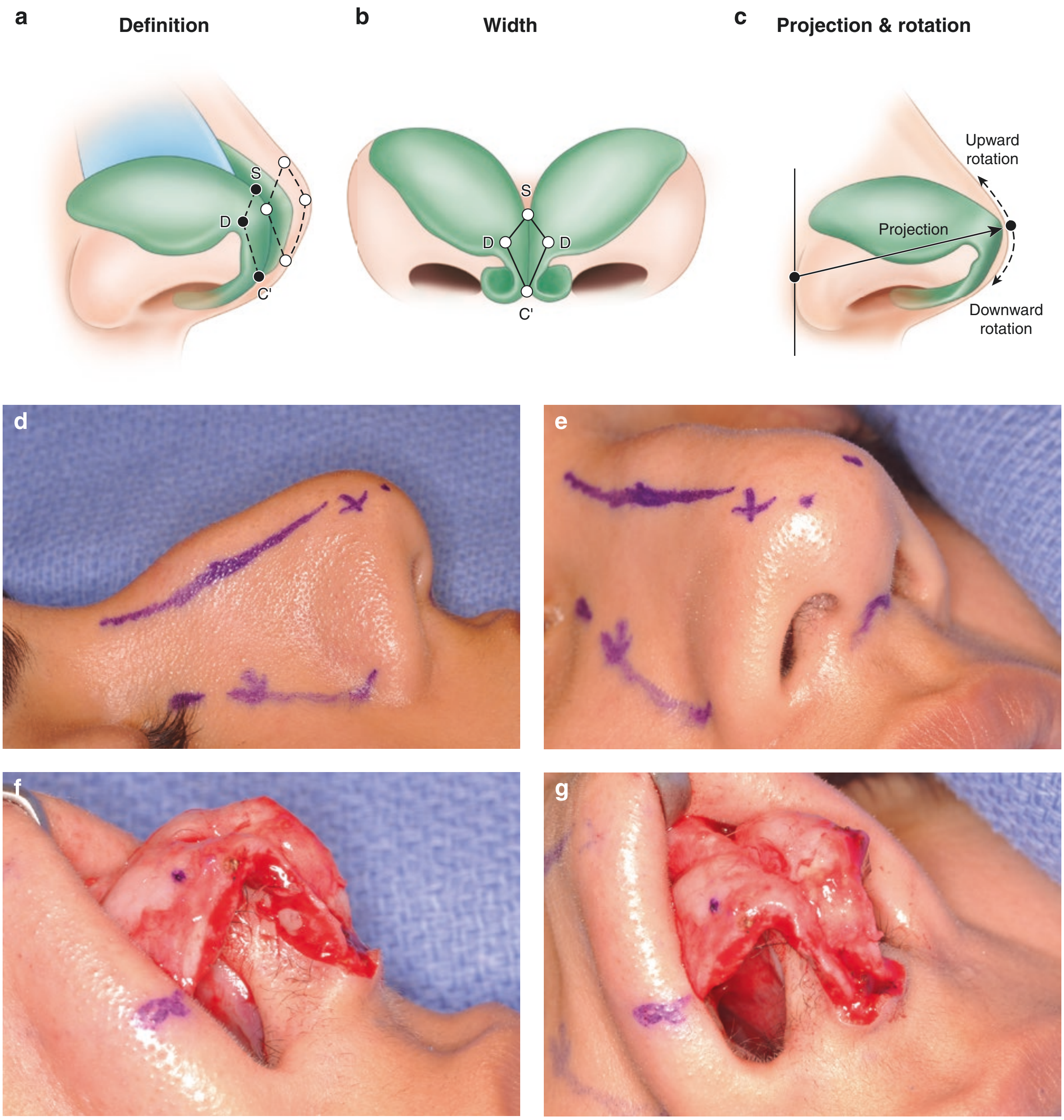

Fig. 7.6 (**a–g**) Tip analysis

Once the STE is elevated, it is important to take a "surgical time out" and review the operative plan based on the newly revealed nasal anatomy, especially the alar cartilages. One should reconcile the planned tip surgery with the actual crural configuration, especially the domes and lateral crura (Fig. 7.6). Sometimes one will encounter unexpected anatomical variations, including marked domal asymmetry (Solution: a concealer graft of excised alar cartilage) or significant concavity of the lateral crura (Solution: a turn-over or turn-under procedure rather than excision). Also, the tip cartilages may be flimsy, calling for more than 6 mm to be preserved, or thick, requiring more sutures. Once the intrinsic tip anatomy has been assessed, then the extrinsic impact of the dorsum and caudal septum and ANS are determined. Also, the surgeon should have a clear idea as to the degree of septal deviation and the amount of cartilage available for harvest.

SYMMETRICAL RIM STRIPS

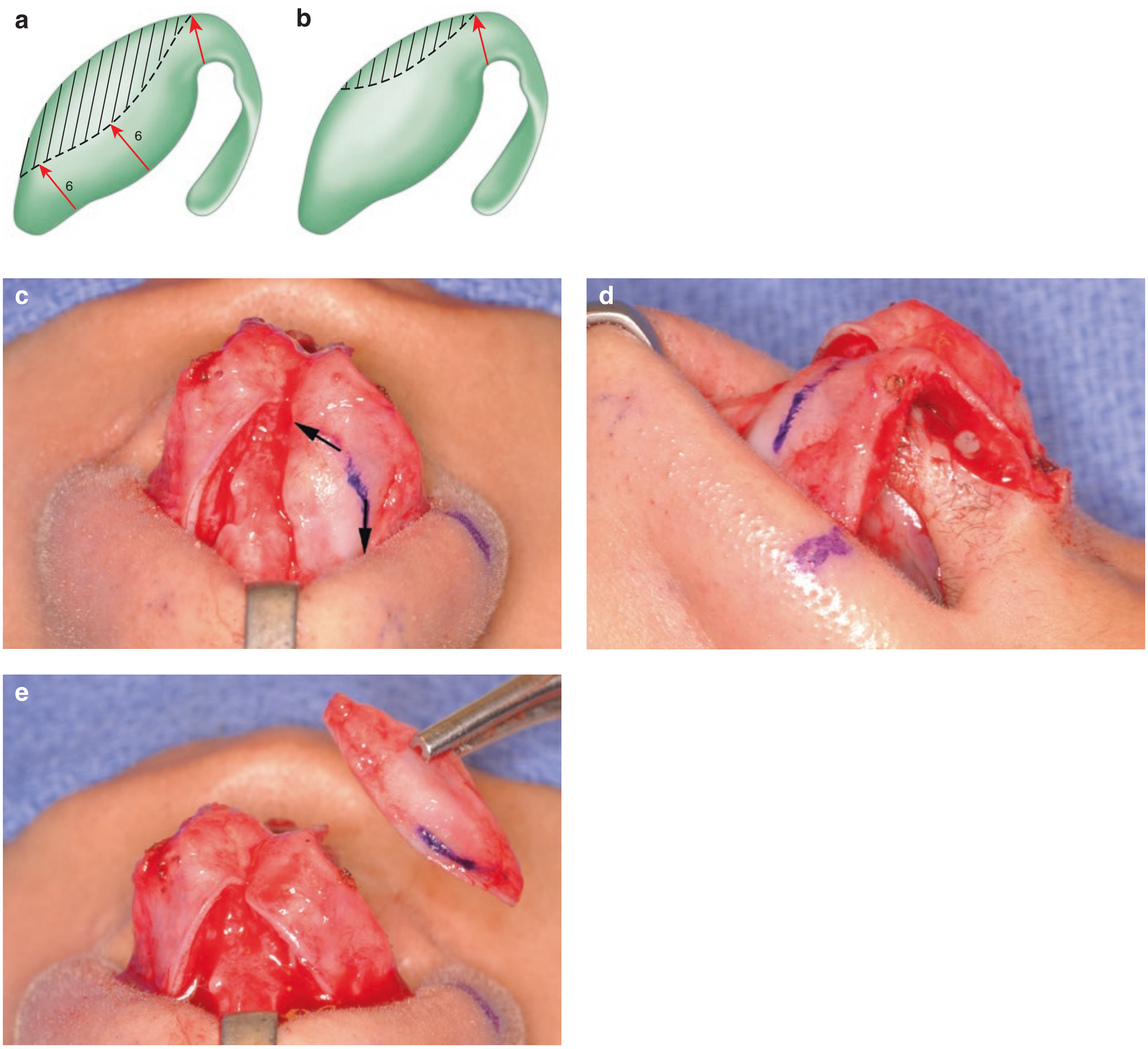

Fig. 7.7 (**a–e**) Creation of symmetrical rim strips

Following STE elevation, one can create symmetrical rim strips by excising a portion of the cephalic lateral crus (Fig. 7.7). This irrevocable step does have several contraindications: (1) significant concavity, (2) severe cephalic orientation, (3) small size of crura, and (4) weak, collapsible crura. We excise a portion of the cephalic lateral crura in 90% of cases, which reduces volume, increases malleability, and reduces convexity. The line of incision is marked on the alar cartilage using a caliper and marking pen. A 6-8mm strip of cephalic lateral crura is left, which facilitates insertion of sutures and retains sufficient support for the rim while minimizing any alar retraction. Three points are important in drawing the incision line: (1) The initial 6-8mm width is drawn at the widest point of the lateral crus. (2) Medially, the line is tapered to preserve the natural width of the domal segment. (3) Laterally, the line follows the caudal border of the lateral crura, preserving a minimum 6-8mm width. Once the line is drawn, the underlying mucosal surface of the alar cartilage is injected with local anesthesia and the incision is made. The actual excision of the cartilage is usually done from the domal notch laterally. Cephalically, the excision follows the scroll junction with the ULCs. Every effort is made to remove the cartilage intact, as it is often used for add-on grafts. One of the advantages of doing the excision at this point in the operative sequence is that it improves visualization for dorsal reduction.

DORSAL MODIFICATION: THE BONY VAULT

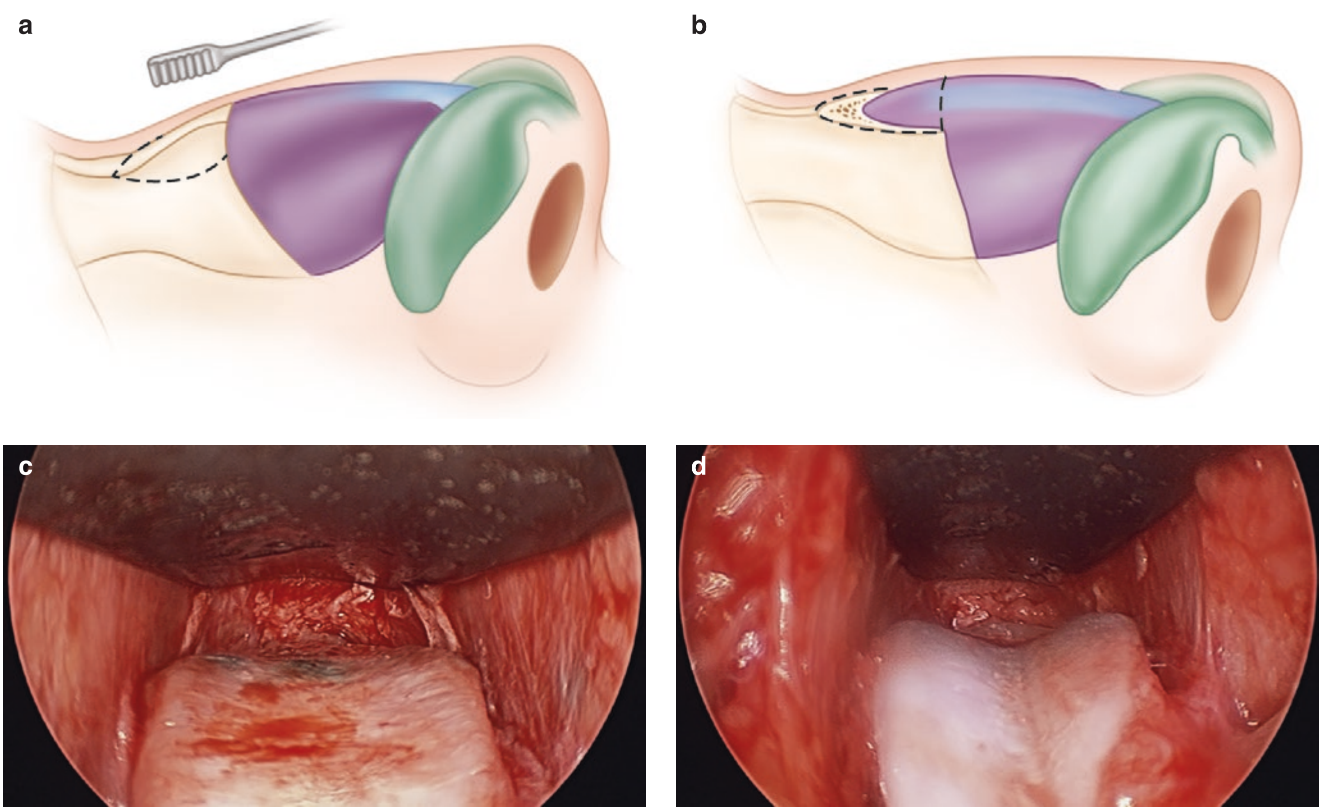

Fig. 7.8 (**a–d**) Bony vault reduction achieved with a rasp for removal of the bony cap which reveals the underlying cartilaginous vault

Dramatic changes are occurring in how we perform dorsal reduction. Based on recent anatomical studies (Palhazi et al. 2015), it is obvious that the dorsal prominence is essentially a bony cap covering a cartilaginous hump; there is no bony hump. These findings confirm our recommended method of dorsal reduction (Daniel 2002). Historically, an en bloc resection of the entire osseocartilaginous vault was done with a guarded osteotome, but this method led to excessive hump removal and was abandoned. Next, surgeons began doing a sequential resection: First, they removed the cartilage vault with a sharp knife and then used a chisel to remove the bony hump. The problem was often "junctional disharmony." The idea of a "split hump reduction" technique was championed by Daniel (2002): The bony component is removed first (Fig. 7.8), and then cartilage reduction is done after splitting off the ULC. Essentially, hump reduction was divided into two steps: bone before cartilage, and then the literal splitting off of the ULC before dorsal reduction. Based on the *bony cap concept*, it is obvious that the bony cap should be rasped off first, leaving the cartilaginous vault intact. Next, the ULCs are separated from the dorsal septum after making extramucosal tunnels. The anterior dorsal septum is then excised with scissors to achieve the desired profile line. Because the ULCs have been preserved, they can be used as spreader flaps. This approach allows maximum preservation of tissue and is done in a graded fashion.

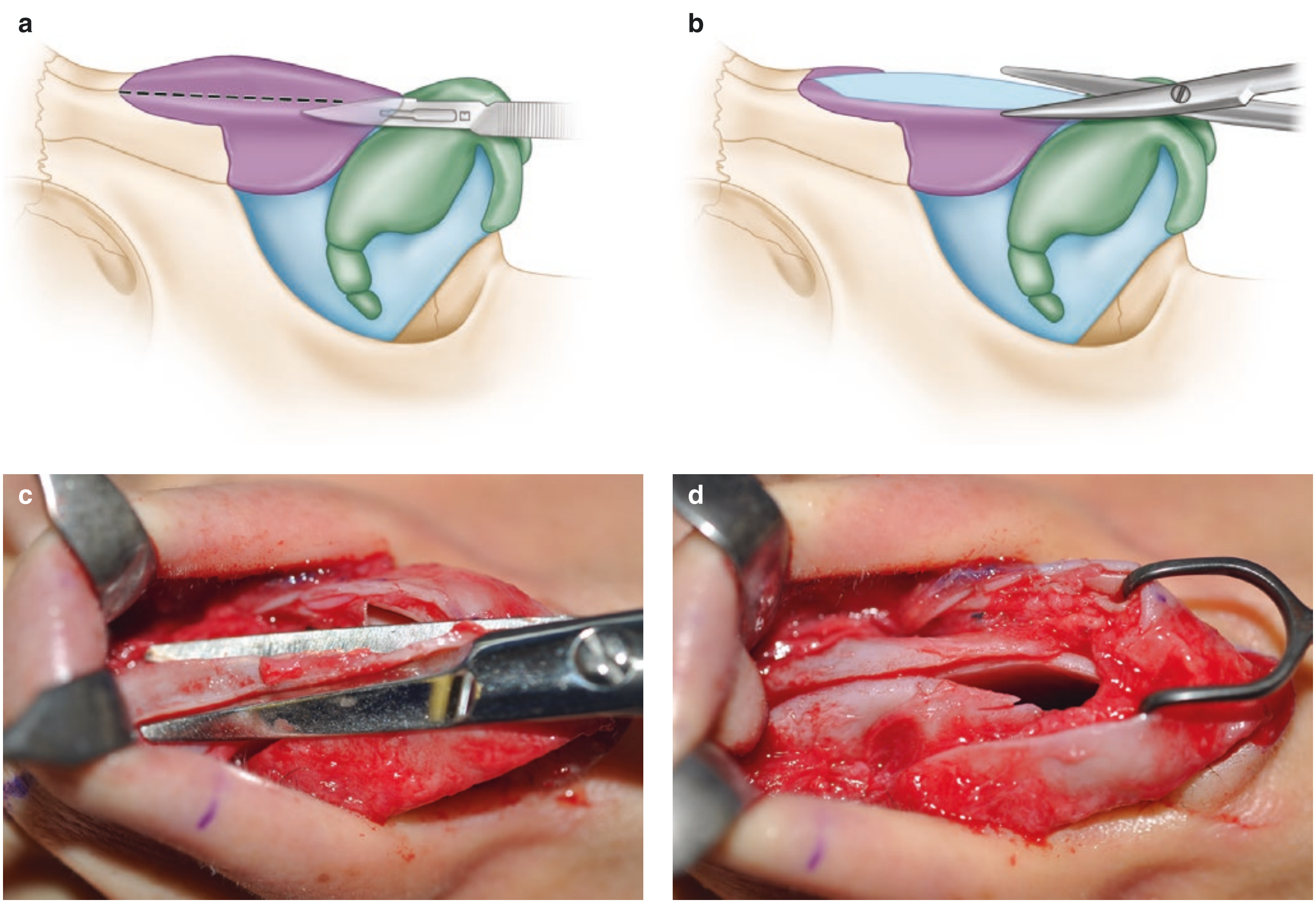

Fig. 7.9 (**a–d**) Cartilage vault reduction and resection

As shown in Figs. 7.8 and 7.9, the dorsal reduction sequence progresses as follows:

1. Subperiosteal exposure of the bony pyramid.
2. Removal of the bony cap using a rasp.
3. Exposure of the intact cartilaginous vault cephalic to the keystone junction (*dotted line*).
4. Creation of extramucosal tunnels.
5. Splitting off of the ULC using a broken-off #11 blade.
6. Lowering of the dorsal septum with scissors (The tip of the scissors extends onto the bone to prevent creation of a dorsal notch.)

This method is strongly recommended because it is incremental, easily mastered, conservative, and it preserves the ULC for potential spreader flaps. Rasping off of the bony cap is the key first step, as it allows preservation of the entire underlying cartilaginous vault. It cannot be stressed too much that there is no open roof until the surgeon creates it by resecting the dorsal septum and cartilaginous hump. The alternative of reducing the cartilaginous hump first makes no sense, as it needlessly removes the more cephalic portion of the ULC, and an osteotome is far more uncontrollable than a rasp. Often, the distance from the initial keystone junction to its subsequent junction following bony cap removal measures 8–12 mm, an area that can be used as spreader flaps within the confines of the bony vault.

CAUDAL SEPTUM AND ANTERIOR NASAL SPINE: MODIFICATION

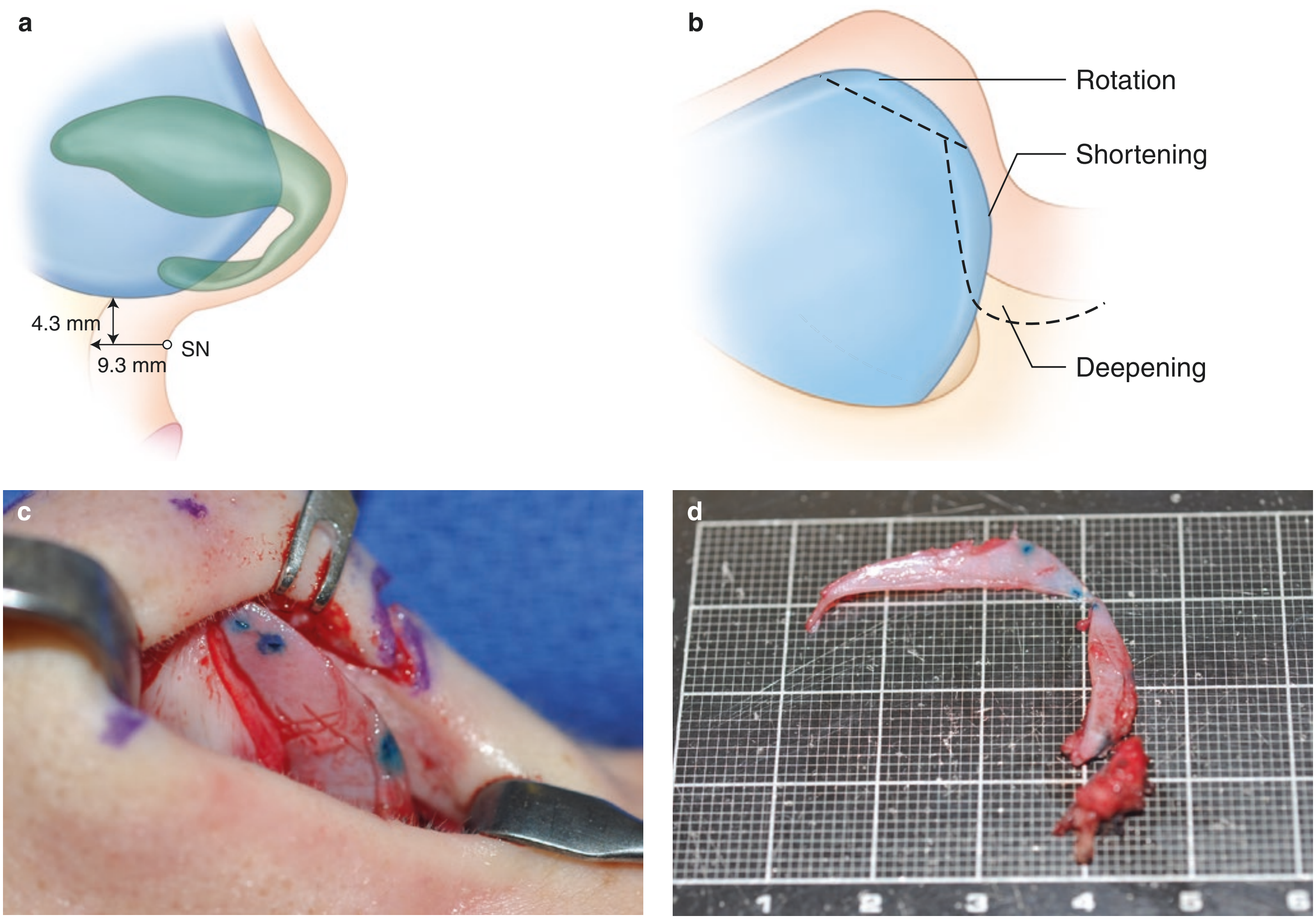

Fig. 7.10 (**a–d**) Caudal septal modification should be conservative in most cases as compared to the radical resection shown in (**c**,**d**)

Modification of the caudal septum and ANS should be done conservatively. Preoperative assessment is essential, both visual and palpable, in repose and smiling. Although the region can be approached through a "tip split" of the alar cartilages, greater control and flexibility is possible through the transfixion incision. Three changes are considered: (1) rotating the tip by resecting the upper half, (2) shortening the nose by resecting the lower half, and (3) altering the columella-labial segment by contouring or resecting the ANS (Fig. 7.10). Minor changes usually consist of cartilage-only resections of 2–3 mm, angled cephalically for rotation, or alternatively a full-length parallel resection for shortening, which maintains the double break. Moderate changes tend to be slightly wider (3–4 mm) but rarely include the overlying mucosa bilaterally. The ANS can either be reduced (excising its prominence while maintaining its contour) or resected (deliberately changing the contour of the columella-labial segment).

RELOCATION

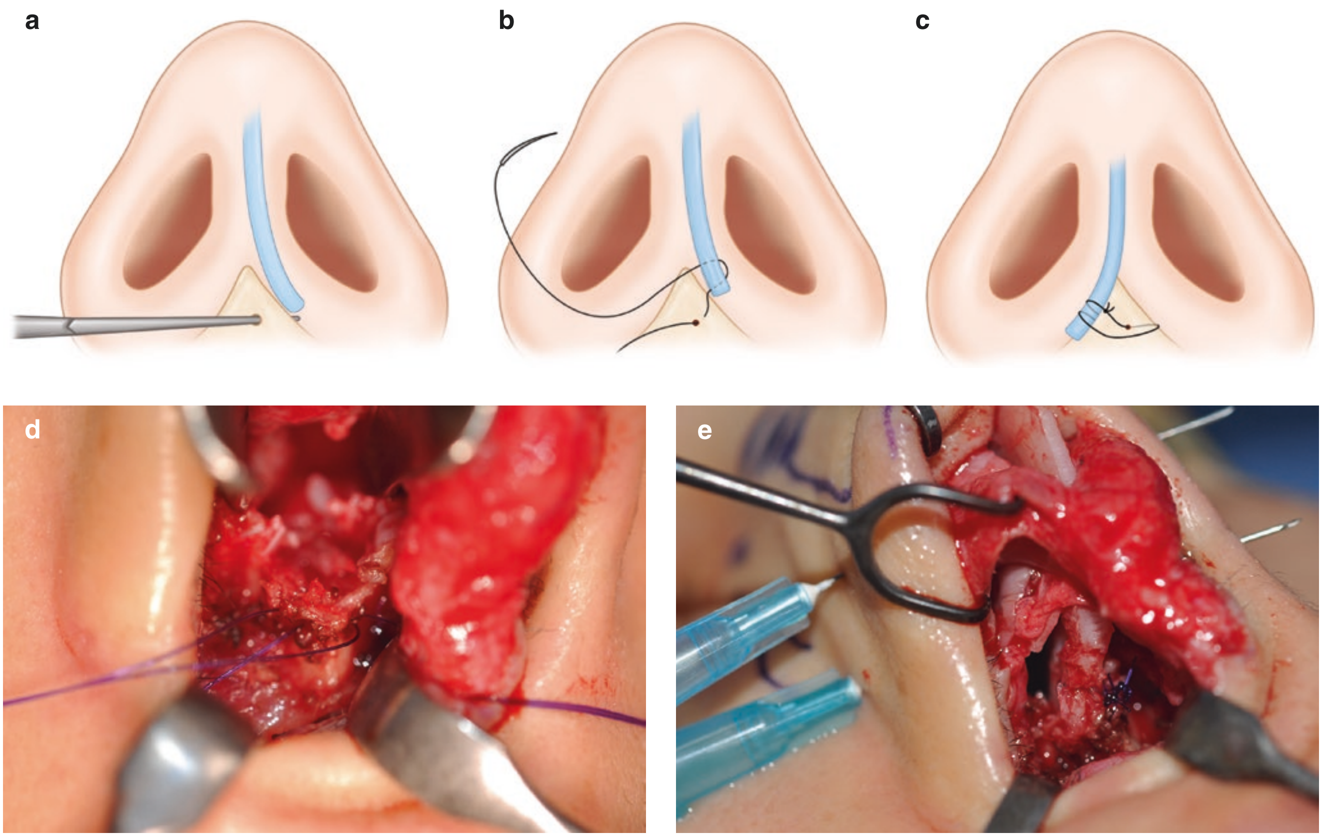

Fig. 7.11 (**a–e**) Caudal septal relocation

Correction of the deviated caudal septum is most easily achieved by relocation (Fig. 7.11). The caudal septum is freed from its bony and fibrous attachments, brought to the midline, and then sutured to the ANS. This method works extremely well if one respects three factors: (1) The caudal septum must be completely released and totally mobile. (2) Fixation to the ANS must be rigid. (3) The structural integrity of the caudal septum must not be compromised by incisions or excisions. The cartilaginous caudal septum is freed from the ANS and a hole is drilled through the ANS. A 4-0 PDS suture is placed through the ANS from the non-deviated side, then through the septum, and looped on itself. The knot is then tied on the non-deviated side of the ANS. When completed, the caudal septum is rigidly fixed on the ANS midline. In cases where the ANS is displaced, the ANS can be partially resected on the deviated side.

SEPTAL HARVEST, SEPTOPLASTY, AND TURBINECTOMY

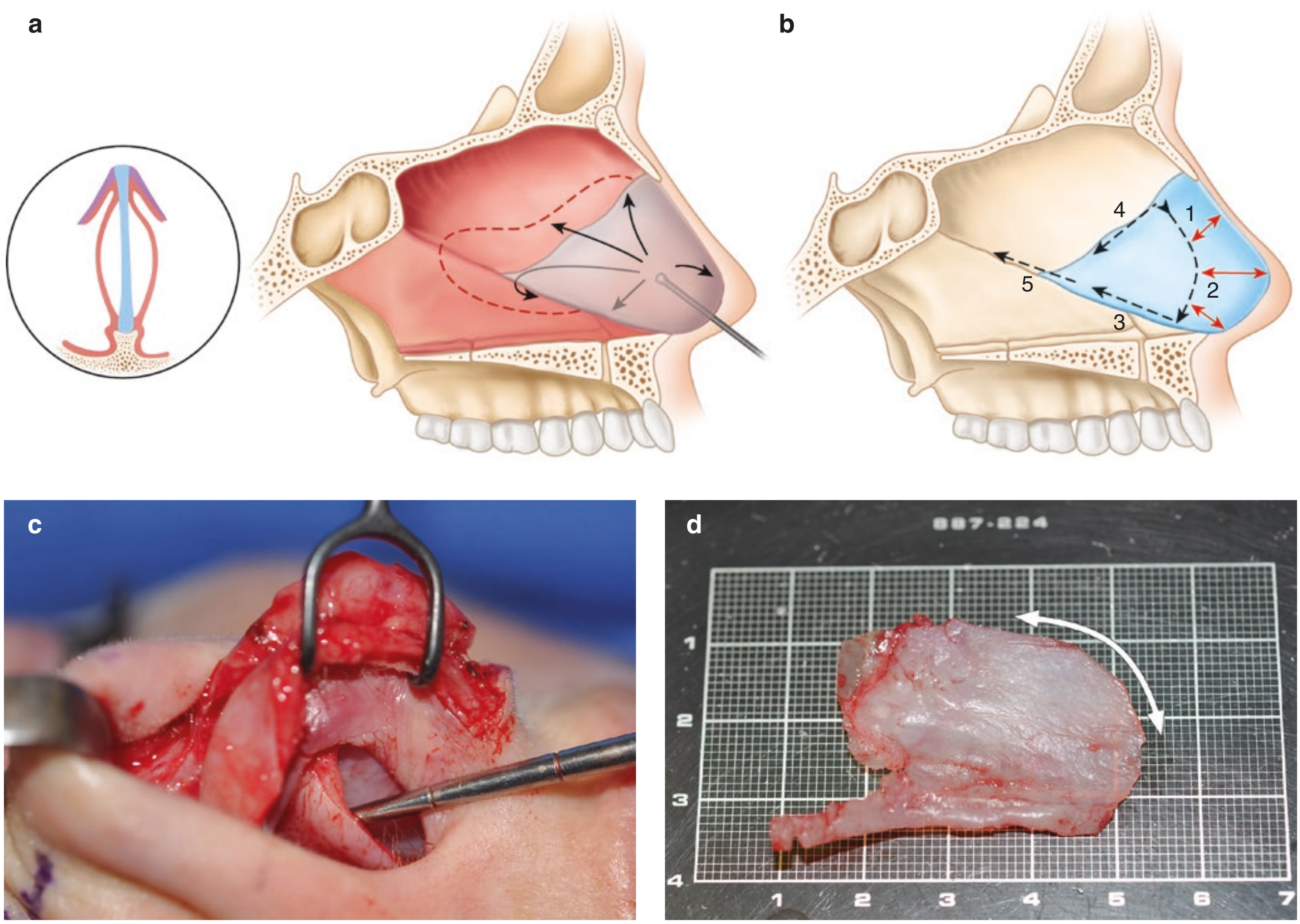

Fig. 7.12 (**a–d**) Septal harvest

Once the desired nasal profile is established, septal correction and harvesting can be done safely. The mucosa is elevated from caudal to cephalic over the upper portion of the cartilage, using the round sharp end of a Cottle elevator (Fig. 7.12). Then a vertical sweep is done back over the perpendicular plate and downward onto the vomer. The inferior mucosa is elevated from the posterior vomer forward, which allows easier separation of the fused perichondrial/periosteal fibers. In significant deviations, it is always best to start on the easier concave side and get a feel for the tissues before doing the more challenging convex side. The actual harvest is done in five steps:

1. A longitudinal cut 10–15 mm below the new anterior dorsum, back to the bony septum.
2. An angled cut into a vertical cut paralleling the caudal septum. Always make a round junction and never a sharp right angle (Fig. 7.12d)
3. Mobilizing the cartilaginous septum out of the vomerine groove.
4. Mobilizing the septal cartilage at its junction with the perpendicular plate of the ethmoid.
5. Mobilizing the sphenoid tail of the septal cartilage.

SEPTAL HARVEST, SEPTOPLASTY, AND TURBINECTOMY

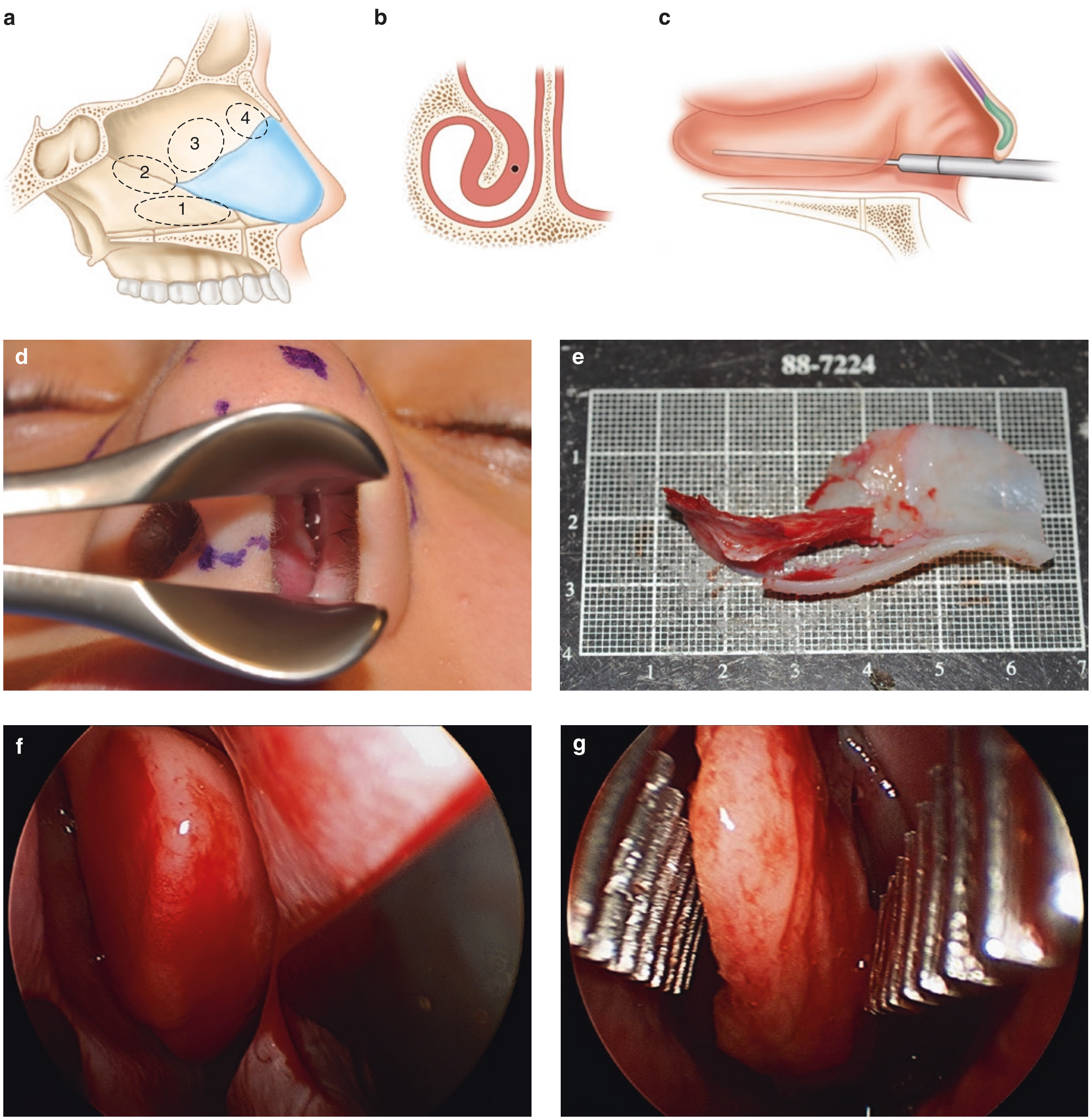

Fig. 7.13 (**a–g**) Septoplasty and turbinectomy

In many cases, the septal harvest is also a definitive correction of a septal body deviation. With this procedure and caudal septal relocation, one can correct the vast majority of septal deviations encountered in cosmetic rhinoplasty cases. Bony septal resection (Fig. 7.13a) most frequently involves resection of bony spurs from the vomerine region. One must cut these sharply and avoid twisting and potential fracturing up into the cribriform plate. Enlarged inferior turbinates are often associated with septal deflections and must be reduced (Fig. 7.13b, c). We prefer radiofrequency coblation followed by out-fracturing, with submucosal bony resection reserved for severe cases.

OSTEOTOMIES: LOW-TO-HIGH AND LOW-TO-LOW

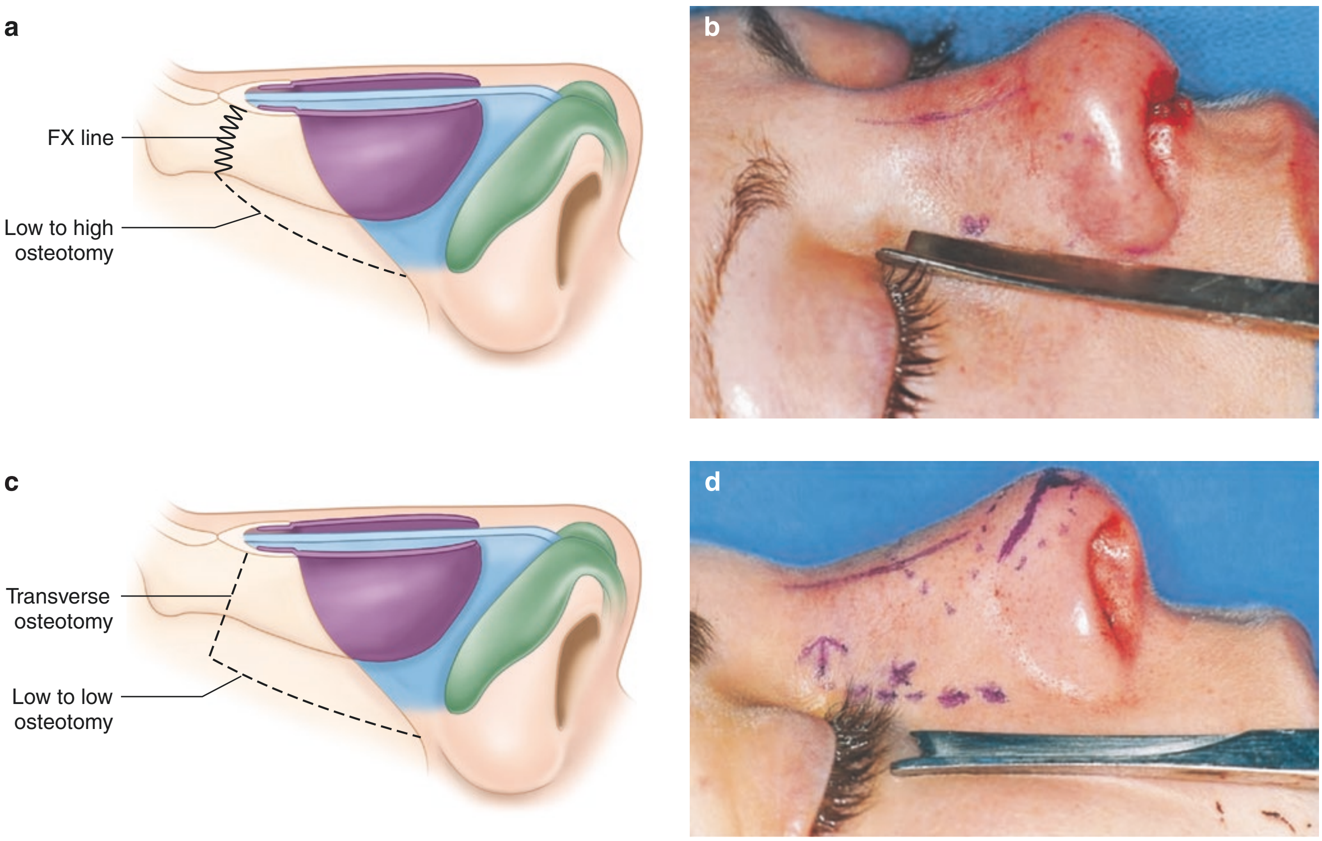

Fig. 7.14 (**a, b**) Low-to-high osteotomy. (**c, d**) Low-to-low osteotomy. fx—fracture

The purpose of lateral osteotomies is to narrow the base bony width (x-x) of the nose as measured at its widest point. The two most common methods are the low-to-high and low-to-low osteotomy, which differ in their direction, degree of bony fracture, and movement. The *low-to-high osteotomy* (Fig. 7.14a, b) begins at the pyriform aperture on the nasal process of the maxilla and passes tangentially across it to the nasal bone suture line at the level of the medial canthus. Next, digital pressure on the lateral wall results in a greenstick fracture of the transverse portion and a gentle tilt of the lateral nasal wall. In contrast, the *low-to-low osteotomy* is done in two steps (Fig. 7.14c, d). First, a transverse osteotomy is done with a 2-mm osteotome placed through a small vertical stab incision just above the medial canthus. The osteotome is gently tapped to ensure a complete vertical osteotomy in the lateral nasal wall. Second, a low-to-low lateral osteotomy is done using a straight osteotome. It begins at the pyriform aperture on the nasal process of the maxilla and passes straight up the lateral wall to end at the level of the medial canthus. Digital pressure produces complete mobilization of the lateral wall and definite narrowing of the nose. The primary difference is that a low-to-high osteotomy preserves bony contact at the transverse greenstick fracture, which limits movement. In contrast, the low-to-low osteotomy incorporates a complete osteotomy transversely, allowing total movement and inward rotation of the lateral nasal wall.

OTHER OSTEOTOMIES

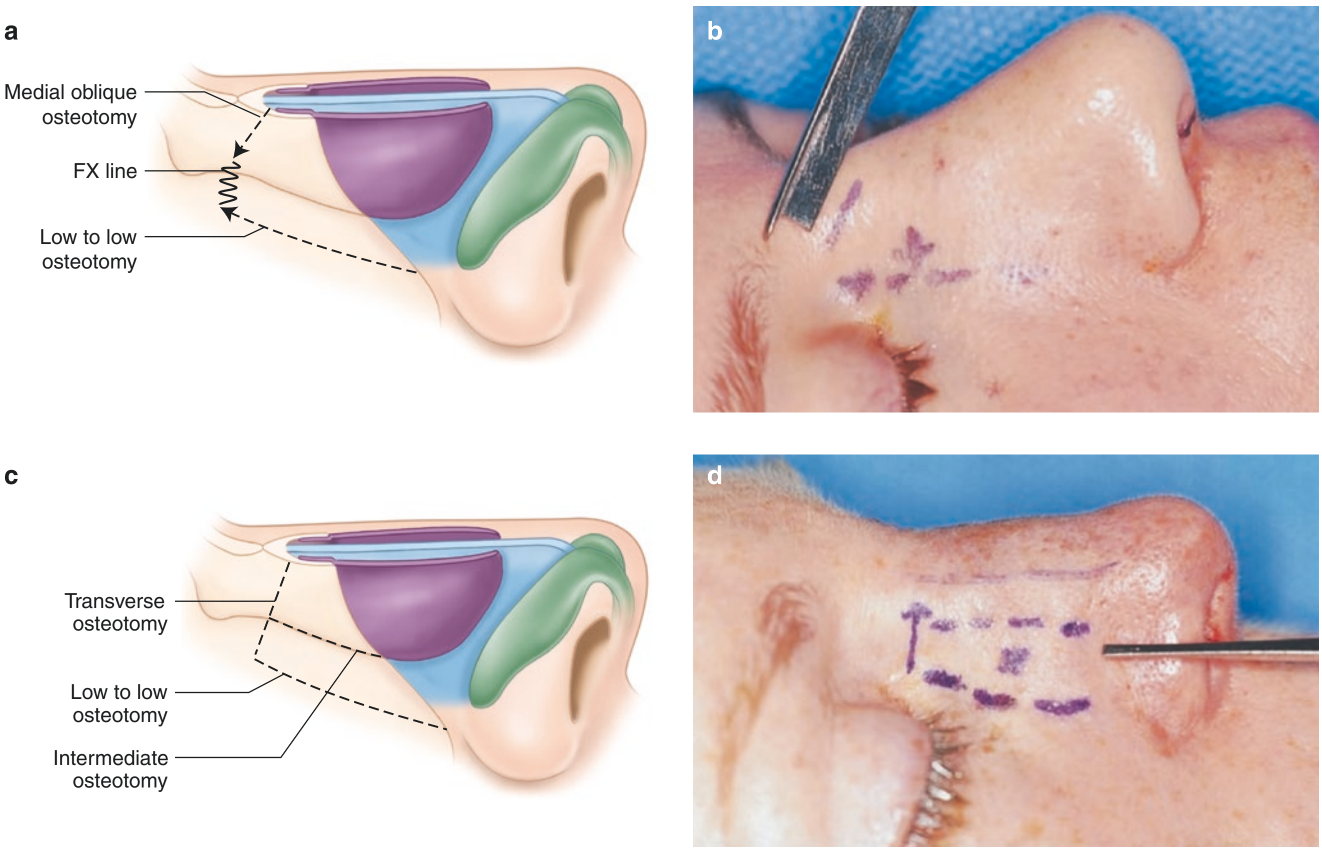

Fig. 7.15 (**a, b**) Medial oblique osteotomy. (**c, d**) Double level osteotomy

On occasion, other osteotomies will be required, including the medial oblique, the double level, the paramedian, and the micro osteotomy. The **medial oblique osteotomy** is designed to narrow the broad bony dorsum and is coupled with a low-to-low lateral osteotomy (Fig. 7.15a, b). A curved osteotome is placed at the cephalic end of the open roof and driven downward toward the medial canthus. The **double level osteotomy** consists of an osteotomy along the inferior border of the nasal bone parallel to and combined with a low-to-low osteotomy (Fig. 7.15c, d). The goal is to reduce the intrinsic convexity of the lateral wall. The higher osteotomy must be done first. **Paramedian osteotomies** are used in the broad nose when one does not wish to change dorsal height. These are essentially straight osteotomies made 2.5–3 mm parallel to the dorsal midline. **Micro osteotomies** are done with the 2-mm osteotome and are used to correct asymmetries or irregularities intrinsic to the bones.

CARTILAGE VAULT RECONSTRUCTION: SPREADER FLAPS AND SPREADER GRAFTS

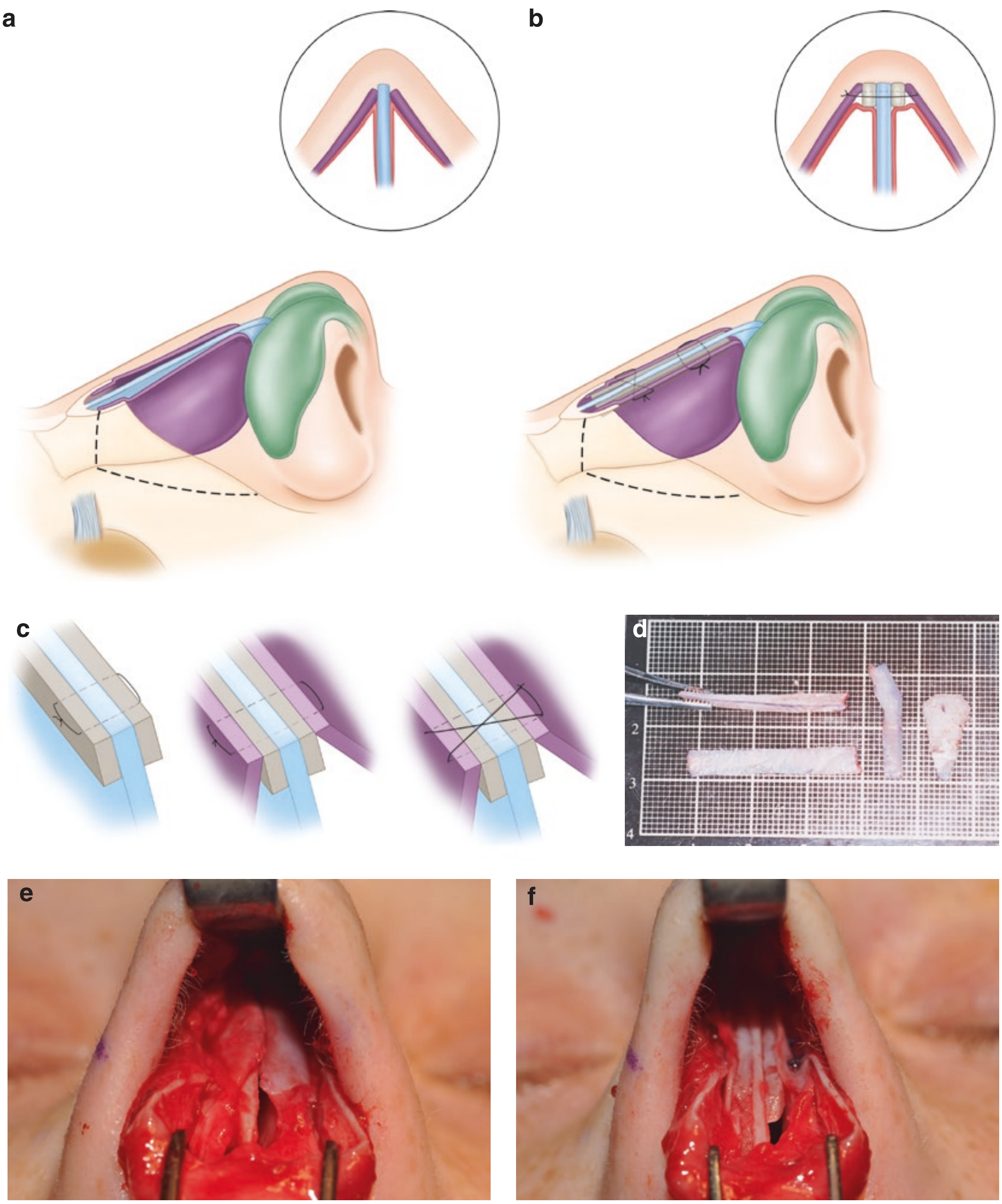

Fig. 7.16 (**a–f**) Spreader grafts

Following a significant dorsal reduction (2 mm or more), reconstruction of the cartilage vault must be done for aesthetic and functional reasons. One must reconstitute the cartilaginous dorsum to avoid a pinched midvault (inverted-V deformity) and collapse of the internal valve angle. We do not consider suturing of the ULC back to the dorsal septum or to its opposite counterpart to be adequate, but because the ULCs were preserved prior to dorsal reduction, they are available for spreader flaps. Equally, previously excised cartilage (dorsum, caudal septum) or septal harvest will provide cartilage for spreader grafts. How does one decide between the two? As a general rule, do spreader flaps if possible and spreader grafts if necessary.

For spreader grafts, there are both preoperative indications and intraoperative necessities. Preoperative indications for spreader grafts include the following: (1) major asymmetries, (2) long midvault/short nasal bones, (3) limited dorsal reduction, (4) extended cephalic bony reduction, and (5) dorsal reduction without osteotomies. Intraoperatively, spreader grafts may be indicated rather than spreader flaps owing to a few conditions: (1) The ULC can be

CARTILAGE VAULT RECONSTRUCTION: SPREADER FLAPS AND SPREADER GRAFTS

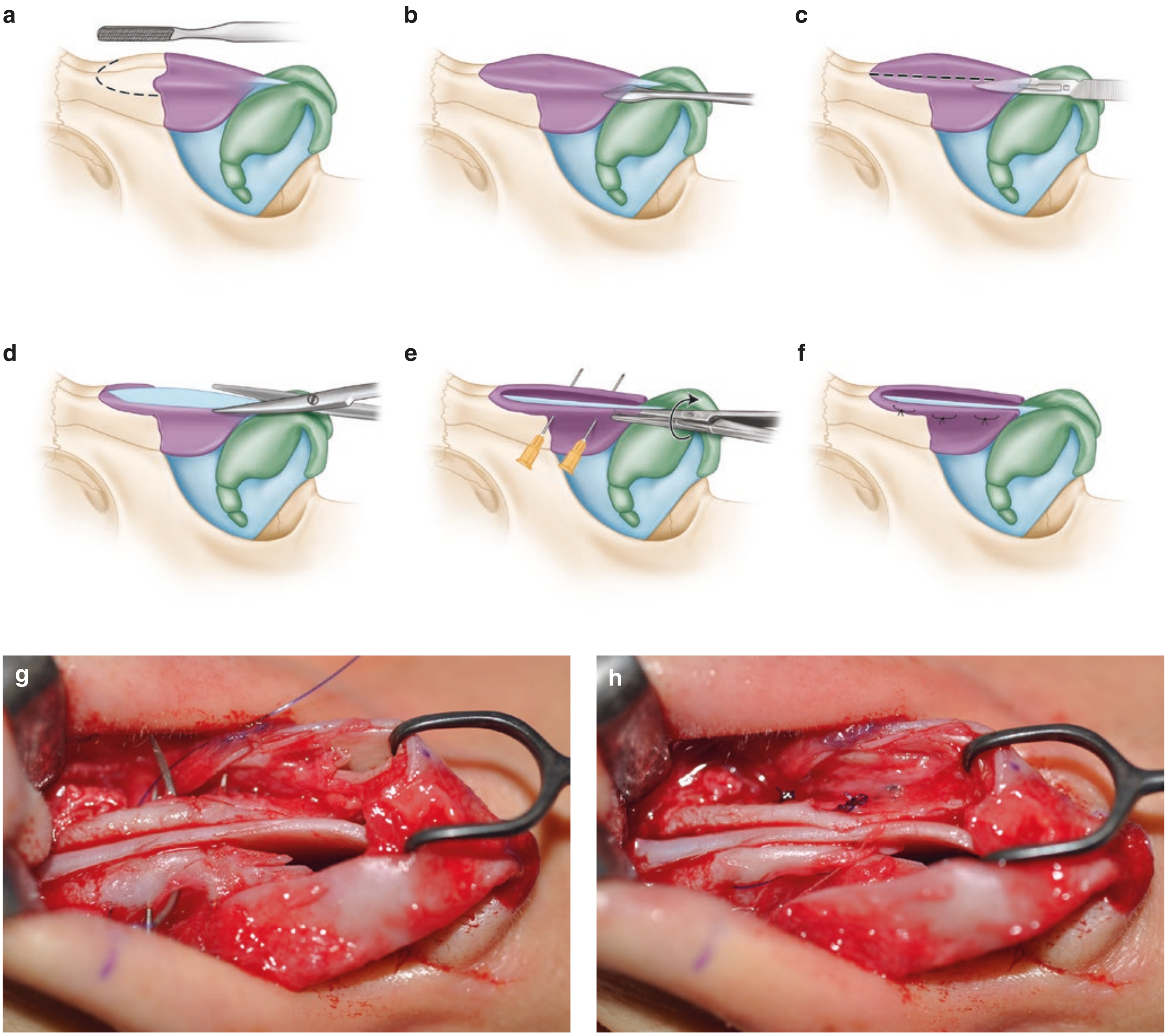

Fig. 7.17 (**a–h**) Spreader flaps

significantly more asymmetric than initially appreciated; (2) Dorsal reduction can be greater than anticipated, in both height (>8 mm) and cephalic extension up to the nasion; and (3) It is necessary to brace or splint the dorsal septum.

Spreader flaps (Fig. 7.16) are easily tested as to their suitability. Simply fold the ULC over and fix it to the septum with #25 needles. When the ULCs are quite rigid, one can incise the ULC along the fold prior to suturing. If there is a deficiency distally near the internal valve, then small, mini spreader grafts can be added. In severe asymmetries, a *combination* of spreader flaps and spreader grafts is often done. One of the advantages of spreader flaps is the ability to sew high up in the bony vault and completely close the open roof, especially when osteotomies are not done. If in doubt and if sufficient cartilage is available, then do spreader grafts (Fig. 7.17)—Do not force the use of spreader flaps. Realistically, one must master both spreader flaps and spreader grafts. I have never regretted doing spreader grafts, but I have considered some spreader flaps to have been a poor decision, especially when the persistence of dorsal asymmetries becomes visible a year or two later. Both procedures have proven equally effective in minimizing nasal valve problems following primary rhinoplasty.

TIP SURGERY: SUTURES

Step	Surgical technique	Effect	Frequency
Step #1	Symmetrical rim strips	Decrease volume	99%
	Cephalic lateral crura excision	More suturable	90%
Step #2	Columellar strut with strut suture	Increases projection	99%
		Prevent drooping	
Step #3	Domal creation suture R & L	Increase definition	95%
Step #4	Interdomal suture	Decrease tip width	90%
		Create tip diamond	
Step #5	Domal equalization suture	Increase symmetry	75%
Step #6	Lateral crural convexity suture	Decrease convexity of lateral crura	20%
Step #7	Tip position suture	Increase projection	75%
		Increase rotation	
Step #8	Add-on grafts	Increase definition	40%
		Increase projection	
Step #9	Alar rim grafts	Support alar rims	10–15%

Table 7.2 Open-Tip suture techniques

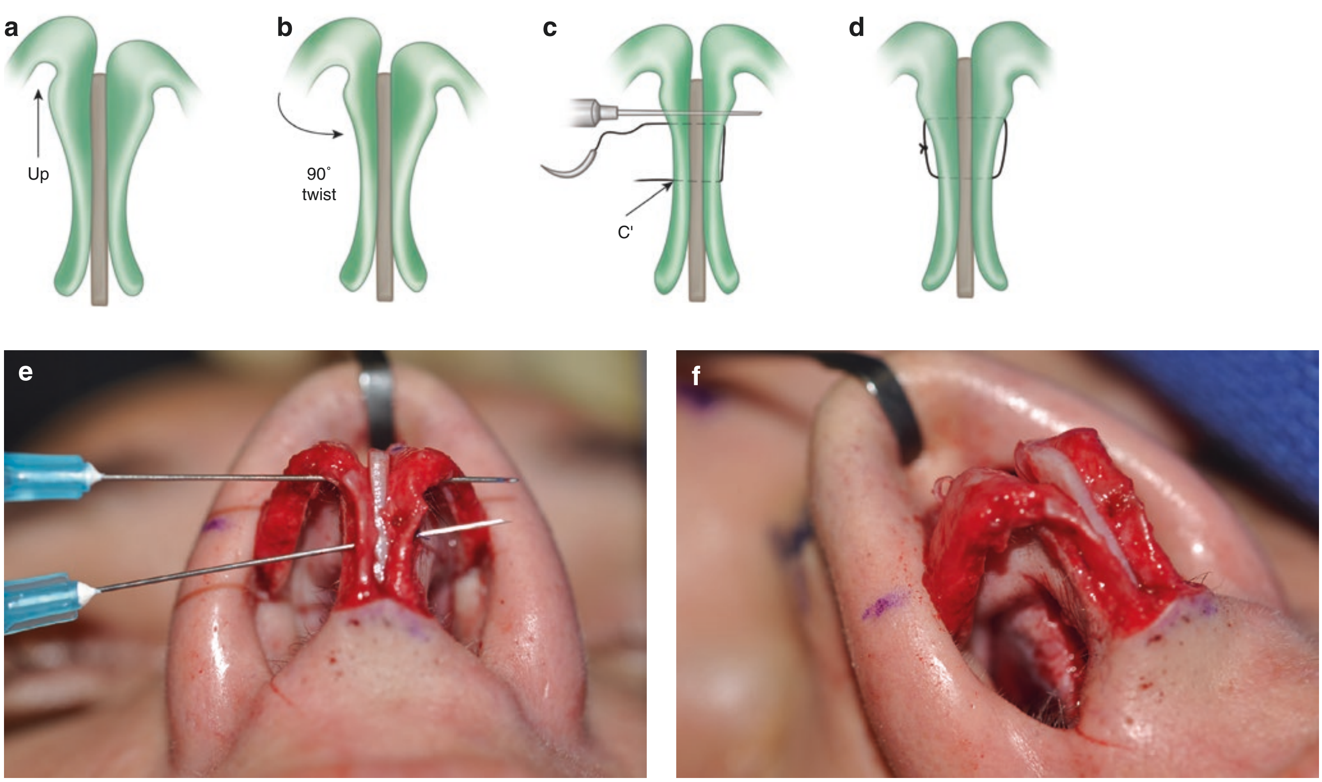

Fig. 7.18 (**a–f**) Columellar strut and suture

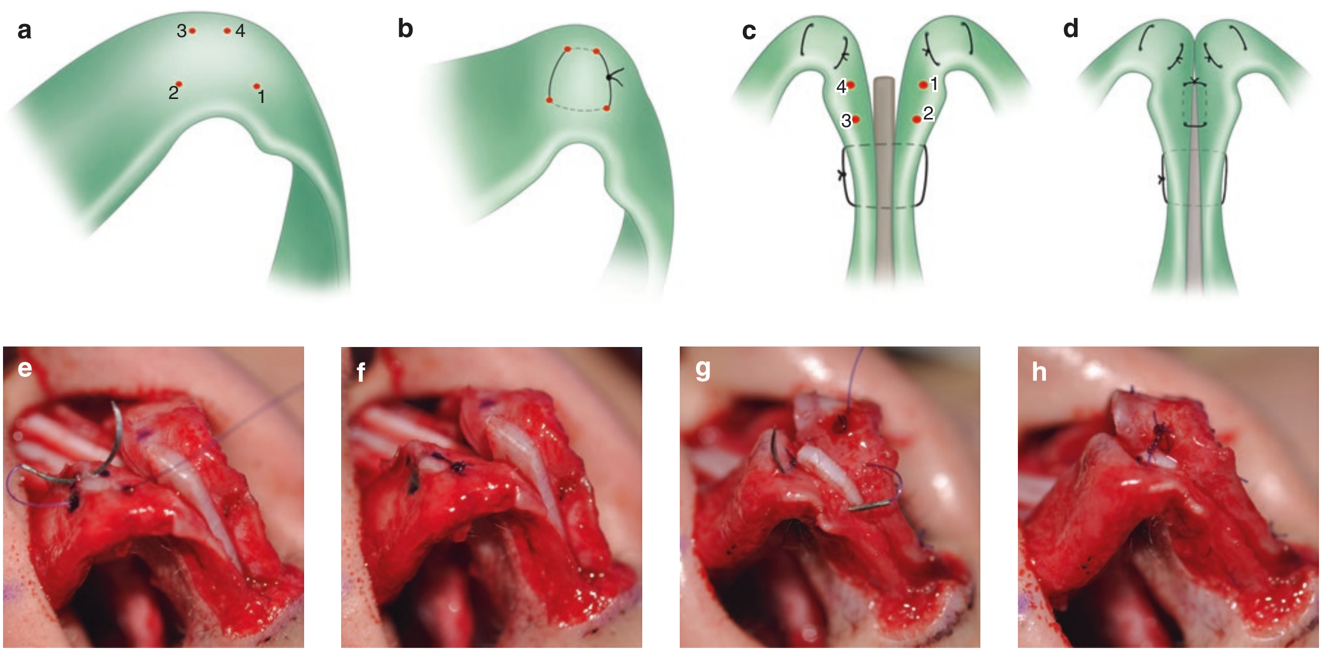

Fig. 7.19 (**a–h**) Domal creation and interdomal sutures

After 30 years of experience (Daniel 1987), it has become obvious to me that an *open tip suture* technique can produce a beautiful aesthetic tip. The open tip suture technique has a flexibility, finesse, and control that is virtually impossible with other techniques, and it should be the basic tip operation mastered first by rhinoplasty surgeons. The proposed operative sequence of the steps on Table 7.2 is as important as the individual sutures.

Step #2 Columellar strut and suture. The columellar strut and suture provides three important benefits: tip stability, intrinsic tip projection, and columellar shape. Suturing the alars to the strut creates a unified tip complex and improves symmetry. The three steps are shaping, insertion, and suture fixation of the strut. The columellar strut is usually cut 20 mm long, 2.5 mm wide, and 1.5 mm thick. A recipient pocket is easily made between the alar cartilages, and the strut is inserted down to its midpoint. Then the alars are elevated upward and rotated 90° medially (Fig. 7.18). They are fixed individually to the strut with a #25 needle placed high on the middle crura just below the domes. This needle placement tends to verticalize the tip. A vertical suture of 5-0 PDS is placed across the columella, sandwiching the strut between the middle crura.

Step #3 Domal creation suture. The domal creation suture produces tip definition by creating the ideal domal anatomy, even from flat or concave cartilages. Essentially, one inserts a cephalic horizontal mattress suture across the domal segment at the domal notch and cinches it down to create a convex domal segment next to concave lateral crura (Figs. 7.19 and 7.20). This anatomical configuration produces the most attractive tip once the skin is redraped. At the present time, I prefer the cranial tip suture (CTS) to the standard domal creation suture (see Fig. 2.35) (Koracevic and Wurm 2014)

Step #4 Interdomal suture. The interdomal suture controls tip width both at the domes and in the infralobule. It is a simple vertical suture that begins on one crus, adjacent to the domal creation suture, exits above the crural suture, then enters the opposite crus at the same level and exits adjacent to the domal creation suture (Fig. 7.19). The knot is gradually tightened until the ideal width is achieved. The simplicity of inserting this stitch is due to its place in the tip suturing sequence.

TIP SURGERY: SUTURES

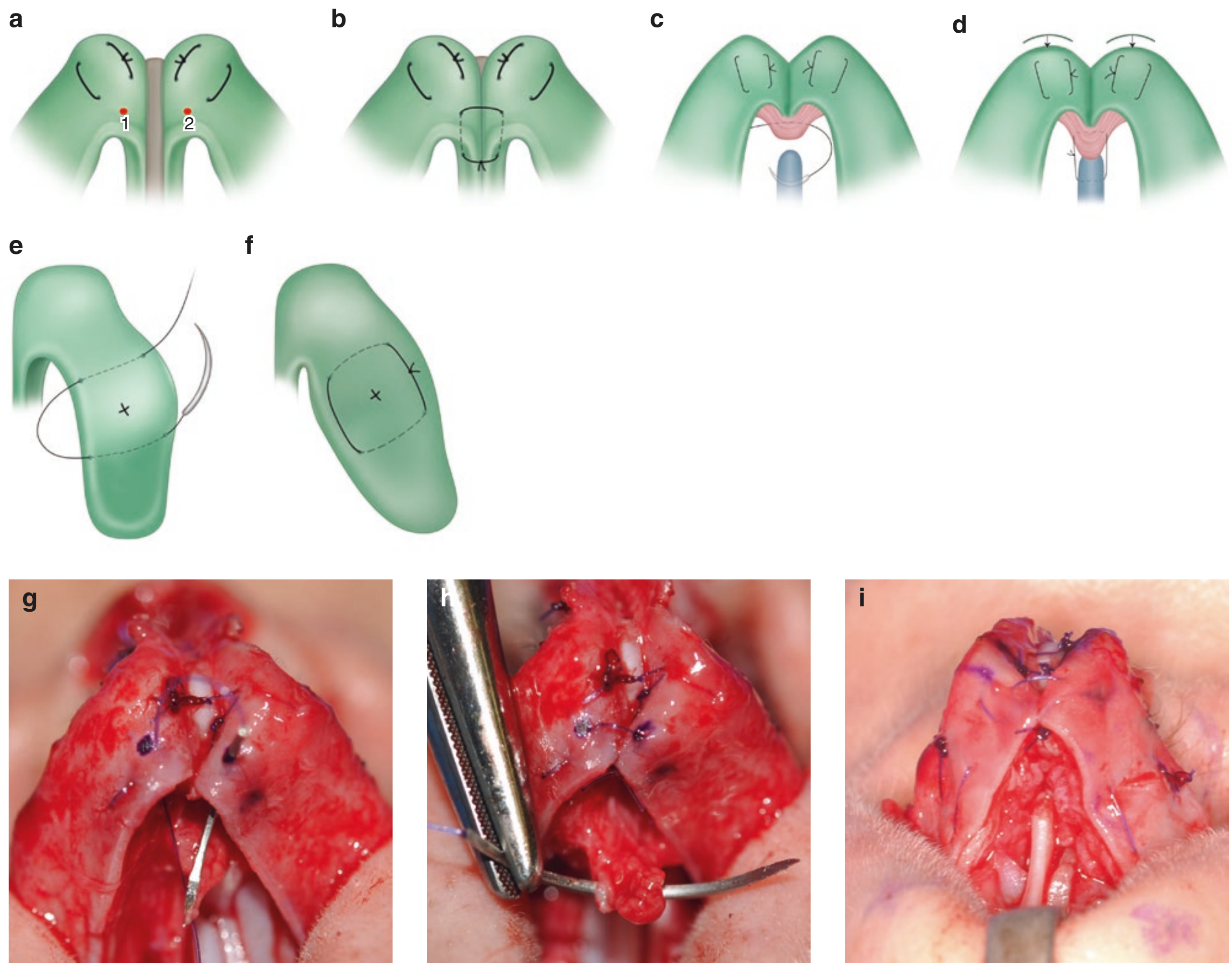

Fig. 7.20 (**a, b, g**) Domal equalization suture, (**c, d, h**) Tip position suture. (**e, f, i**) Lateral crural convexity suture

Step #5 Domal equalization suture. The needle enters the right dome beneath its cephalic edge, exits 1.5–2.5 mm onto the domal segment, then enters at a comparable point on the left domal segment, and exits beneath the cephalic edge of the left. The knot is then tied until the cartilages touch. The suture brings the cephalic edge of the two convex domal segments together, thus creating the apex of the tip diamond. Equally, it depresses the cephalic border of the rim below that of the caudal border, thus moving the tip-defining point toward the caudal border of the domal segment.

Step #7 Tip position suture. The tip position suture achieves both tip rotation and increased projection, which in turn creates the *supratip break* that most patients desire. It is a simple transverse suture between the deep portion of Pitanguy's midline ligament distally and the anterior dorsal septum proximally (Fig. 7.20). As the knot is tightened, the tip rotates upward and projects above the dorsal line, creating a supratip setoff. Early on, one should do a single throw, redrape the skin, and assess its effect. Be careful—over-rotation is a disaster.

Step #6 Lateral crural convexity suture. This suture has revolutionized our treatment of the wide tip, as well as broad, boxy, and ball tips. It is a simple transverse mattress suture that is placed at the point of maximum convexity on the lateral crus. The point of convexity is marked with a pen, and then a mattress suture straddles it perpendicular to the rim strip, beginning from the caudal border. The needle enters about 1 mm from the caudal edge and exits 1 mm from the cephalic edge; then a similar bite is taken 6–8 mm laterally, coming from the cephalic to the caudal border. The suture is gradually tightened until the convexity is flattened.

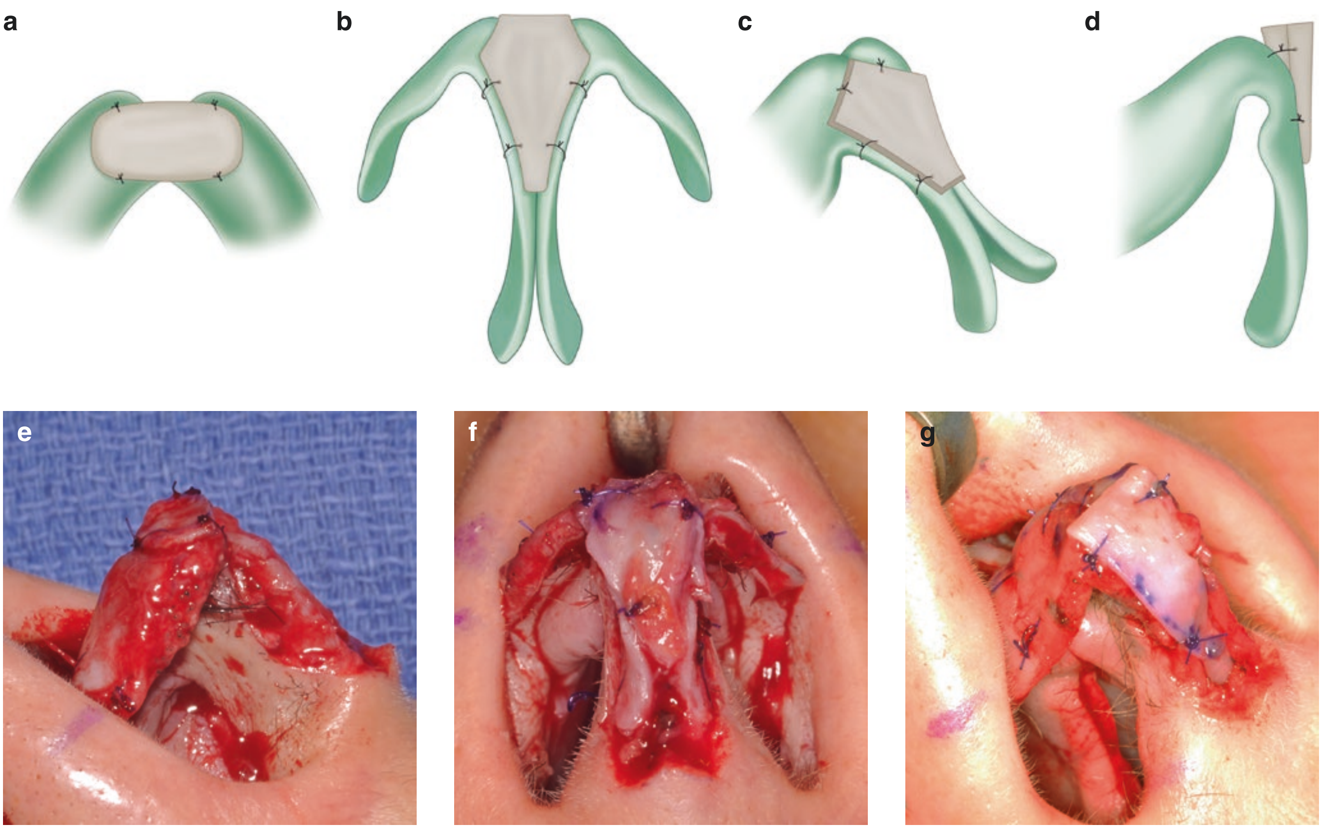

Fig. 7.21 Tip refinement grafts. (**a, e**) Transdomal onlay graft. (**b–d, f, g**) Infralobular graft

Once suturing is completed, small tip grafts can be added to provide additional refinement. These grafts can be placed in different locations and combinations (Fig. 7.21). Initially, these grafts were used as "concealer" grafts to hide tip asymmetry or bifidity under thin skin, but their application has been expanded to include greater infralobular curvature (infralobule position) and tip definition (transdomal position). They are truly "added on" to the final sutured tip to enhance tip refinement with minimal risk. Whenever possible, excised alar cartilage is used, as it is quite pliable, easily shaped, and can be layered. These grafts have minimal risk of showing through the skin, unlike rigid grafts of septal or conchal cartilage. The two most common locations are infratransdomal (Peck-type graft) and infralobular (Sheen-type graft). The *transdomal onlay* graft is placed over the domes to increase tip definition or used as a double layer to slightly increase tip projection. The grafts are sutured to the underlying alar cartilages at the graft's four corners. The *infralobular* graft is cut in a tapered Sheen "shield" style and sutured to the alar cartilages at the domal notch and midcolumellar points. Prior to suturing, the top of the graft can be raised to the edge of the cartilage or slightly above, to either increase projection or accentuate caudal tip position. If the top edge is raised more than 1 mm above the cartilage, then a "cap" graft must be placed behind it to provide ridge support. These cap grafts can be either a transdomal or a vertical wedge, depending upon where tip refinement is desired. Inherently, these grafts also conceal any asymmetries. If the grafts are too visible, the first choice is to remove them. If the grafts are essential, as in an asymmetric tip with thin skin, then one can consider adding a fascia graft to provide thicker soft tissue coverage.

NOSTRIL EXCISIONS AND ALAR RIM GRAFTS

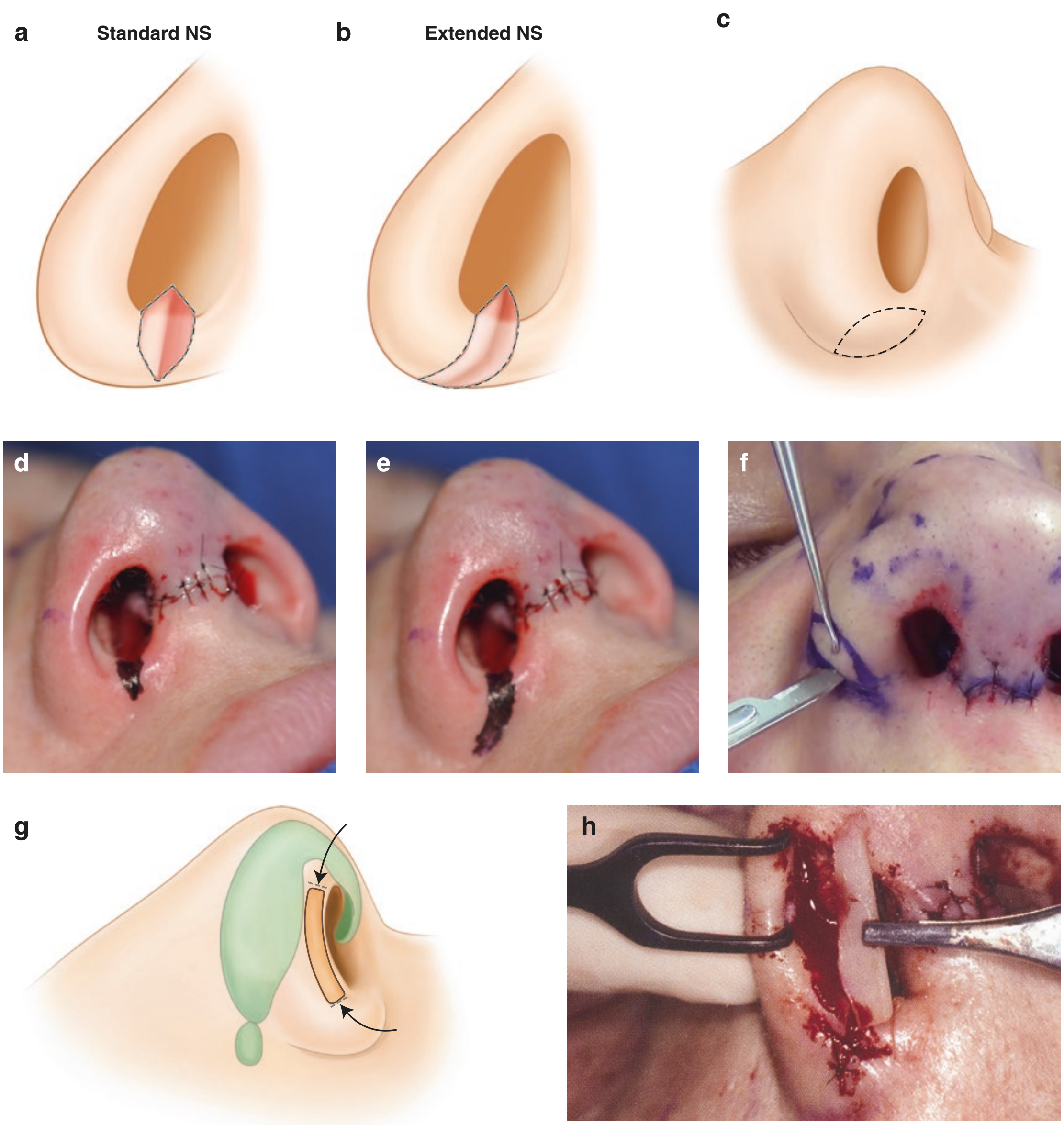

Fig. 7.22 Types of nostril sill excisions include (**a**, **d**) standard and (**b**, **e**) extended with (**c**, **f**) alar wedge excison as an alternative. (**g**, **h**) Alar rim grafts are often necessary following base excisions

Alar base modification should be carefully planned preoperatively and executed very conservatively. Aggressive excisions can be disastrous and are virtually irreparable. The critical decision is whether the alar width (AL-AL) is greater than the intercanthal width (EN-EN) preoperatively.

Nostril Excisions. For *nostril sill excisions*, an inverted trapezoid 2.5–3.5 mm wide is drawn (Fig. 7.22). The sides are vertical and then triangular, with equal extension into the vestibule and on the skin surface. Inferiorly, the excision can stop at the alar crease (standard) or continue along the alar crease for 3–7 mm (extended). For *alar wedge excisions,* it is important that the line of incision be in the alar crease. The elliptical excision is drawn with caliper accuracy (2.5–4 mm average).

Alar Rim Grafts. Alar rim grafts counteract the subtle effects of tip suturing on alar rim shape, both rim retraction and rim depression. Small tapered pieces of rigid cartilage (8–10 mm long, 2–3 mm wide) are placed either subcutaneously along the alar rim (alar rim graft, ARG) or are sutured into a true rim incision (alar rim structure graft, ARS) depending upon the severity of the rim changes.

CLOSURE, SPLINTS, CAST

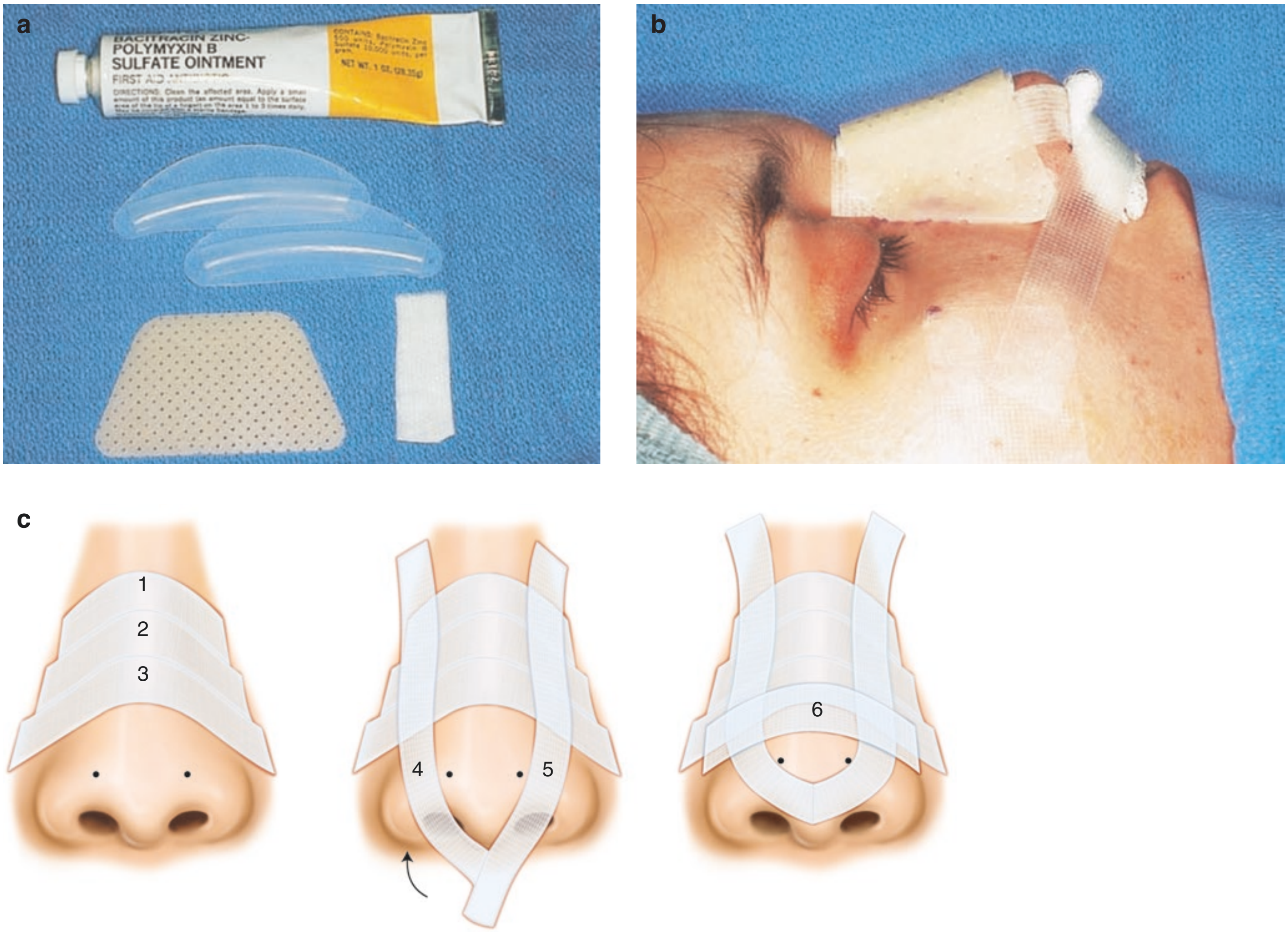

Fig. 7.23 Closure, nasal splints, and cast. (**a**) Ointment, splints, cast, and gauze. (**b**) Cast in place. (**c**) Tape placement

All incisions are sutured. I begin with the transcolumellar incision, starting with midline and lateral corner sutures of 6-0 nylon followed by additional interrupted sutures of 6-0 Vicryl. Then the infracartilaginous incisions are closed with two sutures of 5-0 plain catgut. If there is any evidence of a retracted alar rim, then an alar rim graft is added. The transfixion incision is closed with two or three sutures of 4-0 plain catgut. The classic nasal packing is not used—It is not necessary, and patients hate it. If septal or turbinate work was done, then Doyle splints lubricated with Polysporin ointment are inserted into the nasal airways (Fig. 7.23). The splints are sutured together to compress the mucosal leaflets with a single horizontal mattress suture of 4-0 nylon, which is always tied on the left side. These splints minimize the risk of a septal hematoma and prevent synechiae formation. The nose is then taped with half inch–wide Steri-Strips, which compress the skin envelope, reduce edema, and model the tip. The tapes are applied in the following sequence: (1) three slightly overlapping transverse tapes on the bridge from radix to supratip, (2) two longitudinal tapes placed along the edges of the bridge of the nose and then pinched together to both narrow the tip and support it, and (3) another transverse tape to compress the supratip skin. A small piece of Telfa gauze (4 × 1 cm) is placed along the dorsum to facilitate subsequent removal of the nasal splint. The plastic polymer splint is placed in boiling water to become flexible, molded over the bony portion of the nose, and then instantly “set” by pouring ice water over it.

POSTOPERATIVE MANAGEMENT

The smoothness of the postoperative course is directly proportional to the thoroughness of the preoperative preparation. We give another copy of the "10 Most Frequently Asked Postop Questions" to the patient's caregiver. The patient is instructed to begin pain medication and oral antibiotics (Cipro 500 mg BID for 5 days). Head elevation with ice compresses over the eyes for 36 h is recommended. The drip pad is changed as necessary. Meticulous cleaning of all suture lines with hydrogen peroxide two to three times a day and coverage with antibiotic ointment begins on the first postop day. The patient is seen 1 week later. On the morning that the cast is to be removed, the patient is instructed to take a shower and get the cast and nose wet. The patient is also told to take a pain pill 30 min before coming to the office. The sequence of removing the dressing is as follows:

1. The acrylic cast is lifted off by gently rocking it. (The Telfa dorsal strip allows it to come off without pulling the skin.)
2. The Steri-Strips are removed.
3. The intranasal splints are extracted, after the suture is cut on the left side.
4. All external sutures are removed.
5. The nose is gently cleansed with hydrogen peroxide.

The patient is allowed to see the nose with a mirror—especially the profile view, with the preoperative lateral photograph held beside the head for comparison. Then the patient is taught how to tape and is given a step-by-step "taping diagram" (Fig. 7.23) and a roll of tape. The patient is encouraged to tape the nose at night for 3 weeks to reduce swelling. In patients with thick skin, taping may be done for 4–6 weeks. If the nostrils have been narrowed extensively or I am concerned about their shape, then "nostril splints" are inserted prior to the taping. Patients will use the nostril splints (unilateral or bilateral) at night for 1–3 weeks. When turbinates and complex septal surgery have been done, the patient is encouraged to irrigate the nose with a generic salt water spray. The patient is seen 2 weeks later and then at regular intervals: 3, 6, and 12 months, and then annually thereafter. The usual concerns include bruising, swelling, breathing, smiling, numbness, and initial appearance.

Ecchymosis and Edema. Bruising and swelling are a normal occurrence following a rhinoplasty. Because the patient must be off aspirin for 2 weeks prior to surgery, bruising rarely persists for more than 1 week. Some patients do have a residual bruising in the malar area that can be covered with makeup, and an unfortunate few do get scleral hemorrhage that may persist for 3–6 weeks. Very rarely, a patient of Mediterranean descent will get dark circles beneath the eyes that requires a course of 4% Solaquin Forte topical. Patients are told preoperatively to expect swelling and that it will regress in two stages. Stage I is a generalized swelling that reduces uniformly over the first 2–3 weeks. Stage II is a more gradual period of scar remodeling that follows a constant pattern: bony dorsum, 3 months; cartilaginous dorsum, 6 months; supratip area, 9 months; and tip, 12 months. I emphasize to the patient that they lose one third of their tip swelling by 2 months, the next third between 3 and 9 months, and the final third between 10 and 12 months.

POSTOPERATIVE MANAGEMENT

Breathing. Most patients breathe well, especially after removal of the intranasal splints. They are warned that the splints have been compressing the mucosa and that a rebound swelling may occur for a week or so. They are encouraged to use a nasal spray to replace normal nasal secretions and for mechanical cleansing, both of which are often reduced temporarily following surgery. During the winter, a humidifier and coating of the vestibule and caudal septum with Vaseline is often encouraged to counteract the drying of forced air heating.

Initial Appearance. Before the cast is removed, the patient is reminded of the three preoperative admonitions:

1. The nose will be swollen.
2. The nose will look swollen on front view, but the lines of the nose will be visible on profile view.
3. The tip may appear a bit turned up at first.

The patient is reassured that the nose will look better than it did preoperatively the minute the cast is removed, and that it will gradually get better and better. Also, patients are told that the nose will swell on recumbency and it may swell more on one side than the other, depending on which side they sleep on. Nighttime taping is encouraged. Patients are always given their preoperative photos, as we want them to compare their swollen postop nose, which always looks better than their preoperative photos.

Smiling. When extensive septal work is done, including relocation of the caudal septum, it is not uncommon for patients to complain of a weak smile and limited exposure of their upper teeth. Subperiosteal undermining of the pyriform nasal musculature is the cause, and complete return usually occurs by 4–6 weeks. It is best to warn patient of this potential occurrence preoperatively.

Numbness. Many patients complain that their nose is numb postoperatively. This numbness is due to severance of the continuation of anterior ethmoidal nerves. Although most surgeons consider it a minor problem that always resolves within 6 months, our experience has been different. It is our impression that sensory return takes much longer (12–18 months) and is often partial rather than complete. Again, a prepared patient will more easily accept some reduction in sensation.

COMPLICATIONS

In contrast to the expected associated morbidity of any operation, complications are neither desired nor easily accepted by the patient. Preoperatively, the surgeon must inform the patient about the usual risks and give some idea of their incidence and management. For some surgeons, their biggest error is not the occurrence of the complication, but rather mismanaging it or trying to ignore it. The admonition to be forthright, honest, compulsive, and caring will resolve even the most trying of situations. The following discussion covers the type of complications that the senior author has encountered in the past 5 years.

Incidence of Complications. It is virtually impossible to get an accurate indication of postoperative complications. In absolute terms, my complications for 100 cosmetic cases with a mean 18-month follow-up are hemorrhage 1%, infection 0%, septal perforation 1%, skin slough 0%, scar visibility 0%, nasal obstruction 1%, revisions 5%. Although these data are accurate, the conclusions are merely a "snapshot" of my practice over a specific period. For example, I went 7 years without a postoperative bleed and then had three in 3 months. To my knowledge, the one septal perforation is the first I have had in more than 1000 rhinoplasties in the past 6 years. Thus, is the true incidence of septal perforation 1% or 0.1%? The surgical saying is that if one does enough surgery, one will eventually have every complication, so be prepared.

Hemorrhage. Following recognition of the role that aspirin played in postoperative bleeding, the incidence of hemorrhage decreased significantly. In most cases, intraoperative bleeding can be controlled by cauterization and judicious packing with epinephrine-soaked gauze. Gentle compression over 5–10 min will allow better visualization and cauterization. My impression is that most major bleeds follow medial osteotomies or turbinectomy. In cases involving extensive septal and turbinate surgery, I insert Doyle splints plus gelfoam gauze to completely pack the airway and leave them for 5–7 days. Certainly, the management of postoperative hemorrhage has been greatly simplified by the introduction of nasal tampons (Rhino Rocket®). In my last three bleeding episodes, I have found insertion of a nasal tampon was an excellent first step, and there was no need to progress to cauterization or a posterior pack. Guyuron (2012) has emphasized that bleeds that are not due to hypertension are caused by an insidious coagulopathy. His recommended treatment is DDAVP (desmopressin) intravenous infusion at a dose of 0.3 μg/kg of body weight. We have also found this regimen to be extremely effective, using it both intraoperatively and in the first 24 h postoperatively.

COMPLICATIONS

Infection. Infection following rhinoplasty has decreased to less than 1%. I continue to use prophylactic antibiotics for 5 days postoperatively because of the large number of grafts. In the pre-MRSA era, I encountered two acute infections, both in small revision cases without any septal work or grafts. Both cases required aggressive treatment: (1) incision and drainage, (2) gauze packing, (3) immediate broad spectrum antibiotic coverage plus high doses of penicillin, (4) cultures with subsequent adjustment of the antibiotic, and (5) daily office visits until resolution. Despite a horrendous appearance initially, both wounds healed without scarring, and no further surgery was required. To reduce the incidence of MRSA infections, all patients clean the inside of their nose twice daily for 5 days preoperatively. It is not necessary to do nasal cultures, except in health care workers. Chronic infections with periodic swelling and erythema may be associated with an underlying mucosal cyst.

Toxic shock syndrome (*TSS*) does occur following rhinoplasty, and one must be aware of its symptoms: fever (101–103 °F), hypotension, gastrointestinal tract symptoms (diarrhea, vomiting), and erythematous macular rash with eventual desquamation, with the exclusion of other infectious diseases. In all case studies, the combination of a lethargic, hypotensive, and very sick patient has been apparent. These patients must be treated as a life-threatening emergency and admitted to the hospital. An infectious disease consultant should be brought in, with all nasal packs removed and the nasal airways cleansed.

Septal Problems. Unfortunately, septal hematomas, abscesses, and perforations still occur. I have seen one postoperative septal hematoma that required drainage. I made a unilateral inferior incision and then inserted bilateral Silastic splints. The septal abscess followed a minor dorsal revision *without* any septal surgery. A fluctuant mucosa was obvious bilaterally. Purulent drainage occurred following the incision, and a small length of ¼-inch Penrose drain was sutured into the space to promote drainage. The drain was removed at 4 days, and there were no subsequent problems. Septal perforations following rhinoplasty are infrequent. I am aware of producing at least three, but all have been small, asymptomatic, posterior holes that have not required treatment. In each case, the patient was told that the perforation was present and that surgical correction or a Silastic button was an option if the perforation became symptomatic.

Nasal Obstruction. The reported etiology and incidence of nasal obstruction following rhinoplasty is diverse. In the *early* period, the usual cause is intranasal swelling and lack of normal physiological functions. Certainly, mucociliary transport slows, resulting in stagnation and even obstruction. Cleansing the inside of the nose, either by the physician or by the patient using an over-the-counter saline spray, will usually improve the condition. In the *late* period, one tends to consider either medical or anatomical etiologies. Obviously, a preoperative questionnaire should have revealed the extent of allergic or vasomotor rhinitis, which on occasion will be exacerbated by greater airflow and associated environmental exposure. The appropriate combination of decongestants and nasal sprays can be instituted.

LEARNING RHINOPLASTY SURGERY

After "experiencing" over 6000 rhinoplasties, what advice do I have for the younger surgeon wanting to become a rhinoplasty surgeon?

 # 1 No one emerges from their residency or fellowships being very good at rhinoplasty surgery. The requisite expertise is lacking. One does not have experience with a diverse range of patients or an understanding of surgical cause and effect. It is what you learn and what your commitment is in your practice that will determine whether you become a good rhinoplasty surgeon. The slate is clean; it is commitment that counts.

 # 2 If learning rhinoplasty surgery is so difficult, why bother? The answer is simple—creativity and challenge for the surgeon, and a profound, life-changing event for the patient. There is no other surgical procedure that will fascinate and challenge you throughout your entire surgical career.

 # 3 Where to begin? The first step is to assess your core competence and confidence in rhinoplasty. Your residency and fellowship training will have exposed you to certain techniques. Plan to master these techniques first, within the outline of the basic rhinoplasty operation in this chapter. Begin with easier cases and operate within your comfort zone for the first year or two of practice. Your goal is to become comfortable with the entire perioperative course of rhinoplasty surgery, from consultation through long-term follow-up. This period also establishes your reputation for competency in the community. Despite being cautious, you will have misjudged certain cases and ended up doing a few more difficult cases, thus inadvertently expanding your comfort zone.

 # 4 Every rhinoplasty you do is a learning experience—so maximize it! Take photos of every nose consult and analyze the deformity. Write out an operative plan. If the patient comes back, he or she will be impressed with your preparation, and you can check your initial assessment. Refine your operative plan and record what changes are necessary intraoperatively. Take tip photos before closing. Write out your "three questions" as regards concerns and limitations. See the patient frequently postop and always look at your op diagram. You are the only person who can teach yourself "surgical cause and effect."

 # 5 Read everything you can on rhinoplasty surgery. Attend as many meetings as possible, both local and international. You learn a lot from the lecturers, but also from the other attendees. Do not hesitate to go to multispecialty or different-specialty meetings. I find DVDs are extraordinarily valuable for understanding the details of specific techniques.

 # 6 Find a mentor or visit several surgeons who do a lot of rhinoplasties. The older and more established the surgeon, the more likely they are to help you out. For 1 year, I spent every Thursday morning in the operating room with Dr. Paule Regnault and then every Thursday afternoon doing my own cases. The experience was incredible. Once a year, I spend 2 or 3 days in the operating room with a colleague, and I always learn an enormous amount.

 # 7 Identify your weaknesses and correct them. Because of my plastic surgery background, early in my practice I needed to strengthen my knowledge of managing nasal obstruction, so I took four steps: (1) I took the 3-day Cottle Rhinology course; (2) I went to the Mayo Clinic Rhinology Course and spent a clinical week with Dr. Eugene Kern; (3) I operated with an ENT colleague for 6 months; and (4) I had a resident spend a year developing a “localized rhinomanometry” system.

 # 8 As you develop greater confidence, expand your comfort zone to more difficult cases, but be forewarned: You will have problems and unhappy patients. What to do? Try to be objective. Will a revision make a difference? Should you arrange a consultation for the patient with a colleague? Learn from your revisions. Early on, I was as excited about one of my revisions as I was about a primary, as I got to see what I did wrong. Although I don’t enjoy revisions, it is still fascinating to truly understand what went wrong.

 # 9 Decision Time. Realize that you will reach a point when you need to reassess your commitment to rhinoplasty surgery and at what level you wish to remain. If you have a broad interest in your primary surgery specialty, you may wish to remain at Level 1 and enjoy straightening crooked male noses and eliminating the bumps on teenage girls. The surgery is fun and the stress is limited. Some will want to take on the challenge of Level 2 cases, consisting of more difficult primaries and ethnic rhinoplasties, which will require competency with a large number of grafts. Realistically, only about 10% of surgeons will enjoy doing the Level 3 cases and the infinitely difficult secondary rhinoplasties with their requisite rib grafts. It is important to operate within your comfort zone.

 # 10 A Rhinoplasty practice is a career journey, not a destination. I am convinced that few surgeons would want or could deal with an exclusive rhinoplasty practice for more than 10 years. Although most patients are appreciative and delighted with their result, there is a minority whose unhappiness and anguish erodes one’s soul. As has been said “Be careful of what you wish for; you just might get it.” Yet I continue to suffer from “nose lust” and curiosity about how to correct challenging nasal deformities. I am both cursed and blessed to have had this affliction for the past 35 years. It has been delightful.

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