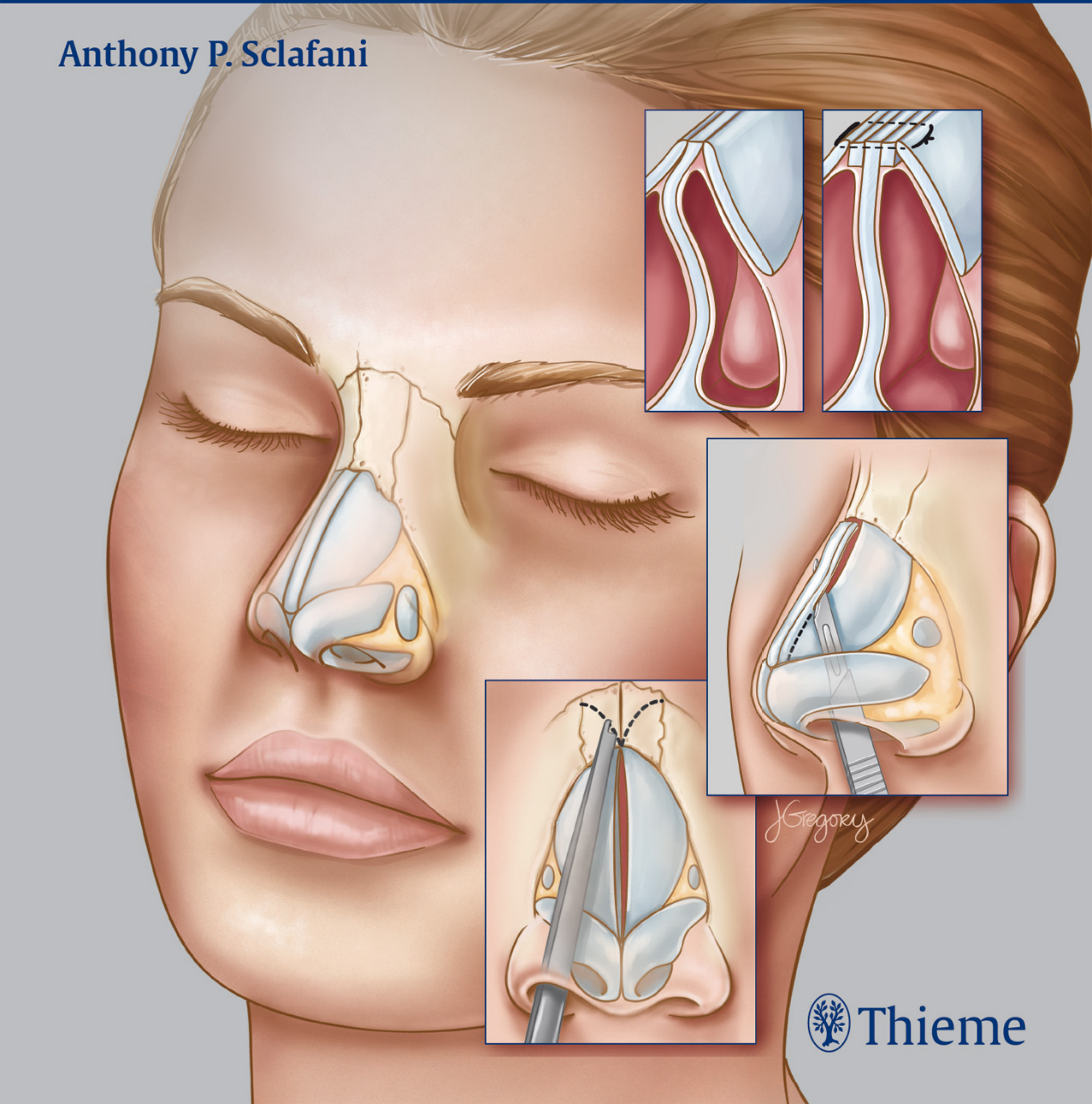
Rhinoplasty

The Experts' Reference

Anthony P. Sclafani



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This book is dedicated to the generations of otolaryngologists
who have pioneered and refined the theory and technique of rhinoplasty.

Contents

Complications in Rhinoplasty

Preface

Rhinoplasty profoundly affects the lives of our patients. When well-performed, it can enhance self-esteem and improve the quality and comfort of life; poorly performed, rhinoplasty can create chaos from relative order, distorting the nasal appearance and potentially crippling the respiratory function of the nose. Visually and structurally, the difference between these two drastically opposite outcomes may be only a matter of a few millimeters. The true difference between these two outcomes is the foundational understanding of the nasal anatomy, the proper analysis, planning of the aesthetic result, the skill techniques, and care of the rhinoplasty surgeon.

Much like Michaelangelo Buonaroti sculpting his David incrementally, using a model partially submerged in milk to reveal only the area upon which he worked, the successful rhinoplasty surgeon must comprehend the internal form of the nose and work to reveal its inner beauty without compromising, but instead exalting, its structure. But how does one become a true rhinoplasty "artist"? Artistic ability can be guided and refined, not bought or sold. However, the technical ability to understand the nature and structure of the nasal form, as well as how this form can be manipulated, can be learned.

The journal *Facial Plastic Surgery* was founded and first published in 1984 in order to develop, refine, and promote the craft of aesthetic surgery of the face and neck. The founding editors, M. Eugene Tardy and Tony Bull, sought to share the expertise of the world's best facial plastic surgeons on specific themes. Throughout the past 30 years, many authors from many countries have shared their knowledge on many topics, and specific issues in rhinoplastic surgery have been covered in many articles. In this, the 30th year of *Facial Plastic Surgery*, we have brought together the best of these articles into a single volume, *Rhinoplasty, The Experts' Reference*. The unique perspective this book brings to the field of rhinoplasty is the focus each chapter gives to a particular topic in rhinoplasty. Some topics are covered in more than one chapter, as different authors demonstrate different approaches to similar problems, much the way Michaelangelo's David must be appreciated from 360 degrees.

The rhinoplasty surgeon, at his/her best, is ultimately a humanist. The ability to understand the goals and desires of the patient, the ability to provide care in a compassionate way, and the "artist's eye" to see the inner beauty and true functioning of the nose must be intimately intertwined with technical expertise and finesse to alter these structures in an organic way to achieve the desired rhinoplasty result. The perfect rhinoplasty may not be an achievable result, but in this quest we strengthen and refine our abilities in forming and reforming the nose. I hope this book serves you well on your journey.

Anthony P. Sclafani, MD, FACS

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I would like to thank Timothy Hiscock, J. Owen Zurhellen, and the entire Thieme Publishers team for their assistance in the preparation of this book. I would also like to express my appreciation to all the authors who have contributed articles on rhinoplasty or other aesthetic or reconstructive facial surgery topics to the journal *Facial Plastic Surgery*.

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Part 1

Rhinoplasty Assessment

1 Functional Anatomy of the Nose

Thomas Koppe, Evangelos I. Giotakis, and Werner J. Heppt

1.1 Introduction

The external nose is formed by a framework of bony and cartilaginous structures that are covered by soft tissue such as muscles and skin. The external protruding nose is a unique formation of human beings. It provides the face with a characteristic shape and profile. It is noteworthy that the typical human nose with downward-facing nostrils appeared first in *Homo erectus*, some 1.6 million years ago.[1] Despite the numerous ethnic differences in the shape of the external nose,[2] harmonious nasal proportions are prerequisites for facial harmony.[3]

1.2 Nasal Appearance

The external nose is pyramidal in shape and can be divided into a dorsum or radix nasi, a nasal tip or apex, and the base of the nose. The triangular base of the nose faces downward, like in all catarrhine primates, and is formed by two alae nasi and the external nares or nostrils. It is further divided by a mobile bar, the columella nasi. The shape of the base of the nose varies greatly among ethnic groups. Hwang and Kang[4] distinguish up to seven shapes of nostrils.

1.3 Angles of the Nose

The most important angles to be considered in nasal analysis are the nasofrontal and the nasolabial angles (▶ Fig. 1.1). The nasofrontal angle measures ~150 degrees in white adults. In Asians and blacks, there is a wider angle. The nasolabial angle measures ~80 to 90 degrees in white males and ~90 to 110 degrees in white females. Like the nasofrontal angle, the nasolabial angle is wider in Asians and blacks. Whereas the nasofrontal angle is not related to the nasal airflow, clinical experience shows that the nasolabial angle plays a definite role in nasal function. The narrower this latter angle, the more vertically the inspiratory airstream enters the nose. From an aesthetic point of view, the nasolabial angle is considered more important than the nasofrontal angle.

1.4 Important Dimensions of the External Nose

Apart from the above-mentioned angles, several measurements exist to evaluate the external nose. Whereas most of these dimensions are based on the measurement between anatomic landmark points, some dimensions measure the distance to a reference plane, such as the nasal basal line (NBL). NBL is defined as an oblique line from the medial canthus to the alar facial groove. The nasal measurements comprise the following dimensions (▶ Fig. 1.2, ▶ Fig. 1.3, ▶ Fig. 1.4):

1. Nasal pyramid height (nasion to columellar base)
2. Nasal pyramid length (nasion to nasal tip)
3. Bony projection (NBL to most prominent part of the osseous dorsum)
4. Cartilaginous projection (NBL to most prominent part of the cartilaginous dorsum)
5. Lobular projection (NBL to most prominent part of the lobule)

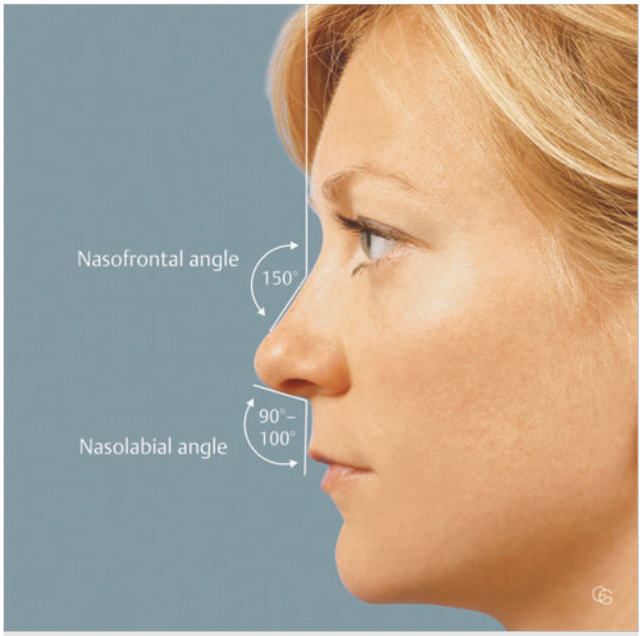

Fig. 1.1 Lateral view of the face with the nasofrontal and nasolabial angles.

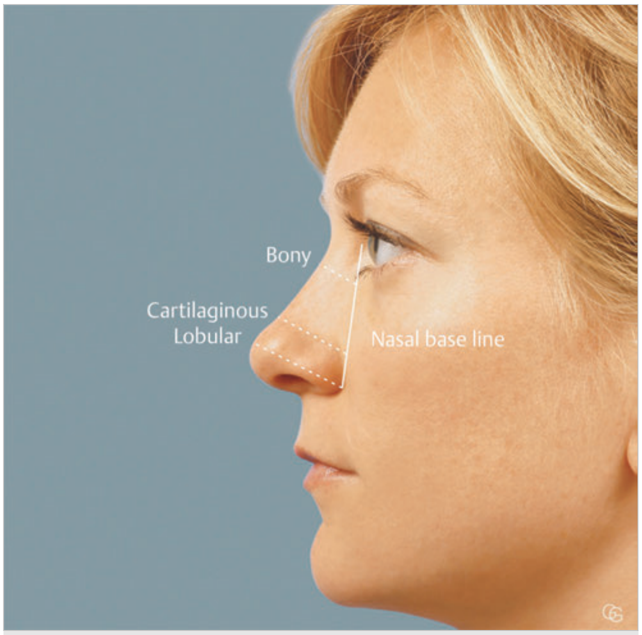

Fig. 1.2 NBL and projection of the bony and cartilaginous pyramid and of the lobule.

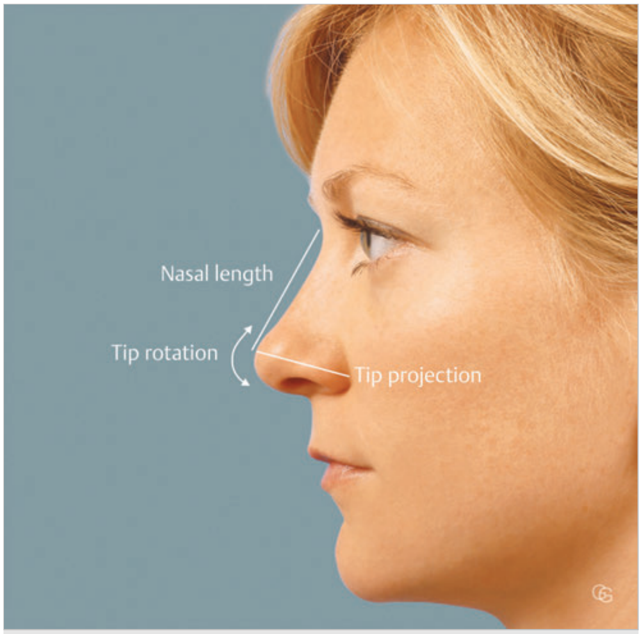

Fig. 1.3 Nasal length, tip projection, and tip rotation in the lateral view.

6. Tip projection (nasal tip to alar facial groove)
7. Tip rotation (tip movement along a circular arc centered at the alar base)
8. Bony pyramid width (NBL at the height of the keystone area, the keystone being the border of bony and cartilaginous dorsum)
9. Lobular width (distance between the right and left lateral walls of the alar cartilages)
10. Tip width (distance between the two nasal domes)

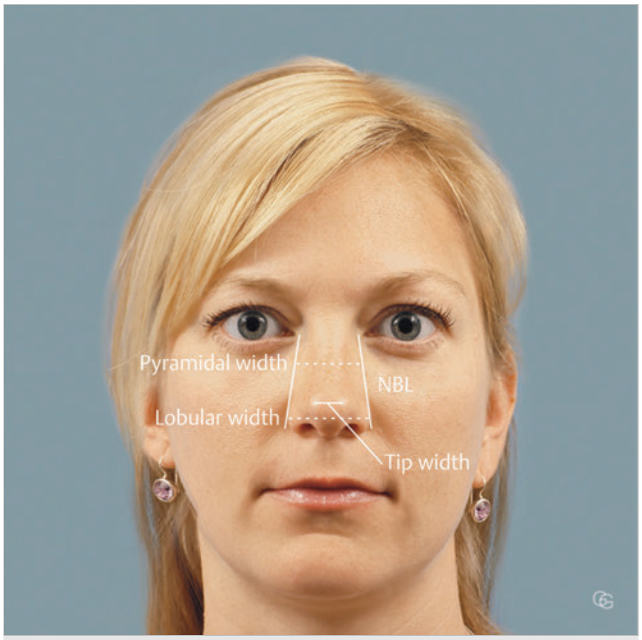

Fig. 1.4 Pyramidal, lobular, and tip width in the frontal view.

1.5 Nasal Pyramid

The major parts of the external nose are the bony pyramid, the cartilaginous pyramid, the lobule, and soft tissue areas.

1.6 Bony Pyramid

The bony framework forming the external nose is composed of the frontal process of the maxilla and the nasal bones (▶ Fig. 1.5). Depending on the size of the nasal bones, the base of the frontal bone may contribute in part to the formation of the radix nasi as well. Lang[5] describes eight different types of ossa nasalia. The nasal bones may be reduced in size or even absent.[6] In some cases, the nasal bones may be subdivided into several pieces. The facial surface of the nasal bone may contain a foramen for an emissary vein. The inferior border of the nasal bone articulates with the lateral nasal cartilage (▶ Fig. 1.5). The external ramus of the anterior ethmoidal nerve passes through the junction of the nasal bone and the lateral nasal cartilage or the lower region of the nasal bone.

The external bony opening of the nasal cavity is the pyriform aperture. Whereas the nasal bones and the frontal process of the maxilla form the upper and lateral margin of the pyriform aperture, the body of the maxilla shapes its lower margin. The lower margin of the external nasal aperture exhibits with the anterior nasal spine a sharp midline anterior projection of the inferior nasal border. From anterior to posterior we can find

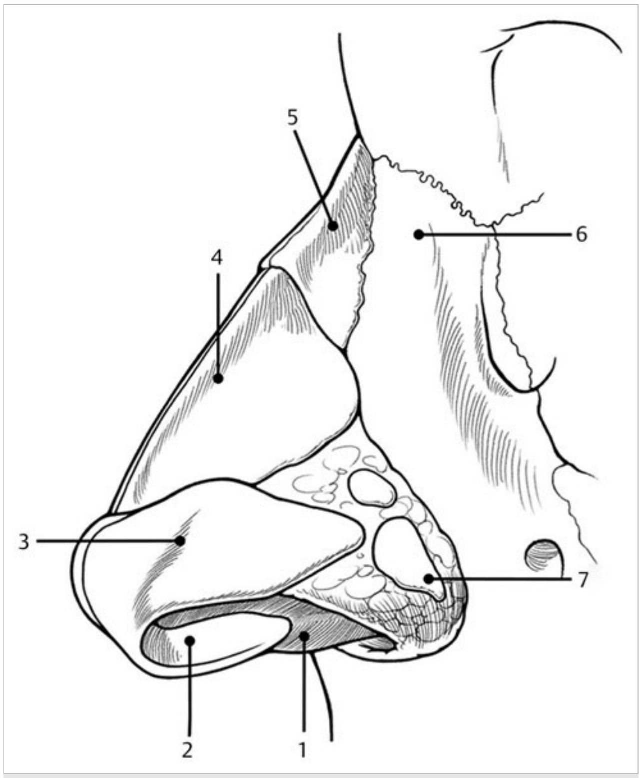

Fig. 1.5 Bony and cartilaginous framework of the external nose from a lateral view. 1, nasal septum; 2, medial crus of greater alar cartilage; 3, lateral crus of greater alar cartilage; 4, lateral nasal cartilage; 5, nasal bone; 6, frontal process of maxillary bone; 7, minor alar cartilage.

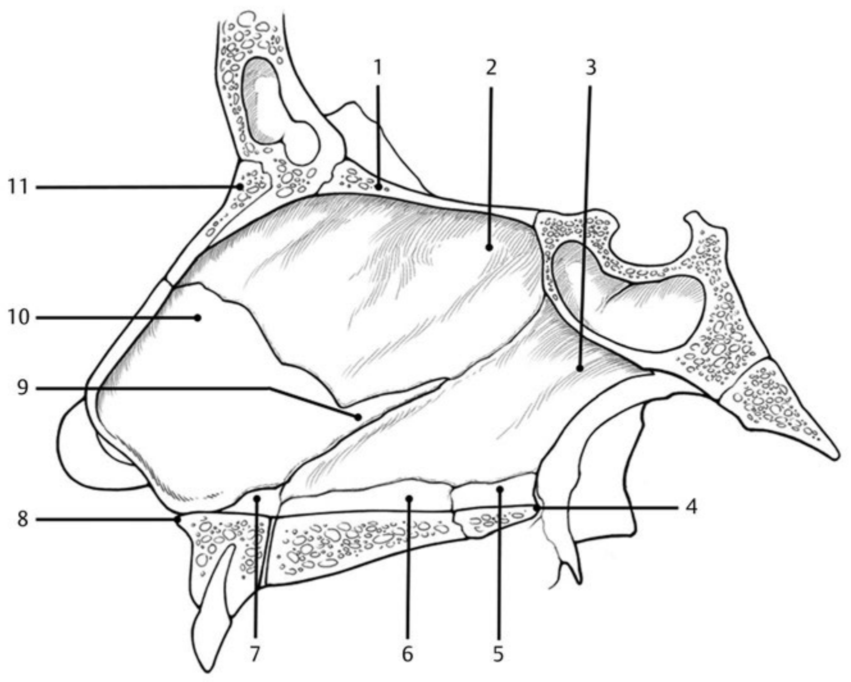

Fig. 1.6 Sagittal section through the facial skeleton with depiction of the nasal septum. 1, cribriform lamina; 2, perpendicular plate of the ethmoid bone; 3, vomer; 4, posterior nasal spine; 5, palatine crest; 6, maxillary crest; 7, premaxilla; 8, anterior nasal spine; 9, (sphenoidal recess of septa) cartilage; 10, septal cartilage; 11, nasal bone.

the premaxilla, the maxillary crest, and the palatine crest. The posterior end of the palatine crest is the posterior nasal spine (▶ Fig. 1.6).

1.6.1 Clinical Pathology of the Bony Pyramid

Exact anatomic knowledge of the bony framework helps in understanding various pathologic entities and surgical procedures. Pathologic conditions after trauma, like nasal bone fractures, need to be accurately analyzed before deciding the appropriate reduction technique. Apart from a good physical examination, new diagnostic methods like nasal bone sonography[7] and digital volume tomography[8] have started to play an important role in the analysis of a nasal bone fracture. In addition to the new diagnostic methods come new reduction techniques like the endoscopically assisted nasal bone fracture reduction.[9] To perform osteotomies during a rhinoplasty (importance of NBL) or to analyze a crooked nose with a bony deviation, the anatomic knowledge of the bony nasal skeleton is of great importance. Moreover, a prominent frontal process of the maxilla should always be considered as a possible cause of nasal obstruction. Submucosal reduction of this part of the maxilla can be proved helpful in functional endoscopic sinus surgery or in cases of nasal obstruction; minimizing the mucosal trauma results in lower complication rates and faster patient recovery. Premaxillary retrusion or deviations are also anatomic features that should be corrected as they may cause both functional problems and distortions of the aesthetic appearance of the nasolabial area. Various premaxillary augmentation techniques are described in the literature (e.g., cartilage and bone grafts or Mersilene [Ethicon Inc., Somerville, NJ] mesh).[10] Another important pathology of the maxilla, which should be considered in the differential diagnosis of nasal obstruction in infants together with septal displacements, nasopharyngeal mass, choanal stenosis, and atresia, is the congenital nasal pyriform aperture stenosis.[11]

1.7 Cartilaginous Pyramid

The cartilaginous pyramid, consisting of the cartilaginous nasal septum and the upper lateral cartilages (▶ Fig. 1.5, ▶ Fig. 1.6, ▶ Fig. 1.7), is a T-shaped construction with a variable angle ranging from 15 degrees at the valve area to 80 degrees at the K-area (keystone area). This anatomic feature of the external nose is of great importance in conditioning the inspired air and breathing. The cartilaginous nasal septum connects caudally, from ventral to dorsal, with the anterior nasal spine, the premaxilla, and the vomer (▶ Fig. 1.6). Cranially, it is connected to the two upper lateral cartilages. Caudally, it has a free connection with the columella, and dorsally it is connected to the perpendicular plate of the ethmoid bone. The perpendicular plate of the ethmoid bone connects cranially to the cribriform plate of the skull base and dorsal and caudal to the vomer and the sphenoidal crest. The olfactory fibers run through the cribriform lamina and end intracranially at the olfactory bulb. Antonio Scarpa in 1785 was the first to describe an extensive plexus of olfactory nerve fibers. The upper lateral cartilages are connected cranially to the caudal margin of the nasal bones (underlap of ~1 to 2 mm). The caudal margin of the upper lateral cartilage (ULC) is free and protrudes into the vestibule. Its lateral side is covered by skin and is named "cul de sac." Dorsally, it is connected with the lateral soft tissue (or "hinge") area. The medial third of the caudal margin is usually rotated upward 160 to 180 degrees (returning, scrolling, or curling). There are a variety of possible connections of the ULC and the lower lateral cartilage (LLC). The most common finding is an overlap of the caudal margin of the ULC by the cranial margin of the lateral crus of the LLC. Variations include end to end connection, scrolling, or opposite scrolling. In the connective tissue between the two cartilages, several sesamoid cartilages can be found.

The cartilaginous pyramid also contributes to the formation of the nasal valve area, first described by Mink.[12] The nasal valve area consists of an internal or inner nasal valve and an external or outer nasal valve. The nasal valve area controls the inspiratory air flow and can be considered as the area of maximum nasal flow resistance.[13] The internal nasal valve is located supero-lateral between the lower margin of the ULC, which is overlapped by the greater alar cartilage (see later) and the anterior part of the nasal septum. The external nasal valve corresponds essentially with the nostrils and is formed by the lower margin of the alar cartilage, the columella, and by the skin.

1.7.1 Septal Cartilage

Whereas the septal cartilage (or quadrangular cartilage) is a perpendicular plate, the lateral nasal cartilages are flat extensions of this movable part of the nasal septum. Together with the perpendicular lamina of the ethmoid bone and the vomer, the septal cartilage is part of the nasal septum (▶ Fig. 1.6). Recently, it has been demonstrated in pigs that the septal cartilage may be involved in absorbing energy from masticatory loads.[14]

Depending on the degree of enchondral ossification of the nasal septum, the septal cartilage may be enlarged by a posterior or *sphenoidal* recess that can reach the anterior border of the body of the sphenoid bone (▶ Fig. 1.6). The septal cartilage is 2 to 4 mm thick.[5] It is thicker at its anterior and posterior margins and thinnest in the middle. The cartilaginous septum widens at several locations, such as its base, the junction of the ULCs, and the anterior septal body. At the region of the anterior septal body, we can find thickened areas of mucosa, the anterior tubercle, and the septal intumescentia (▶ Fig. 1.7). The mucosa at these two regions resembles erectile tissue. The *lower margin* of the septal cartilage is connected to the hard palate by rim-like cartilaginous tissue. The position of the anterior septal angle varies to some degree. Studying 35 cadavers, Potter et al[15] found the septal angle in 68% of cases below the lower margin of the lateral nasal cartilage. Only 32% of specimens showed a septal angle at the lower margin of the lateral nasal cartilage. In addition, it should be noted that the anterior part of the septal cartilage is connected to the anterior nasal spine by a special arrangement of collagenous fibers. This connection is of great importance when performing a septumplasty. If this connection is disturbed during the surgery, it has to be reconstructed to secure stability of the nasal septum with the nasal spine (e.g., using a figure-of-eight suture).

A distinct feature of the lower anterior part of the nasal septum of many mammals, including primates and humans, is the vomeronasal organ, or Jacobson's organ (▶ Fig. 1.7). It is related to the detection of pheromones.

1.7.2 Lateral Nasal Cartilage (Upper Lateral Cartilage)

Even though the current *Nomina Anatomica* considers both the septal and lateral nasal cartilages as distinct, non-united cartilages, clinical workers found that both cartilages are usually connected with each other to some degree.[15] The position of either the septal or lateral nasal cartilage (or triangular cartilage) in relation of the lower margin of the nasal bones is of great clinical importance. There is a tight connection between the ULC and the nasal bone. In addition, the perichondrium of the ULC is continuous with the periost of the nasal bone.[16] In a study of white cadavers, Potter et al[15] observed that the lateral nasal cartilage underlapped the nasal bone on average by 14.97 mm laterally. Sagittally, the greatest underlap of 8.63 mm

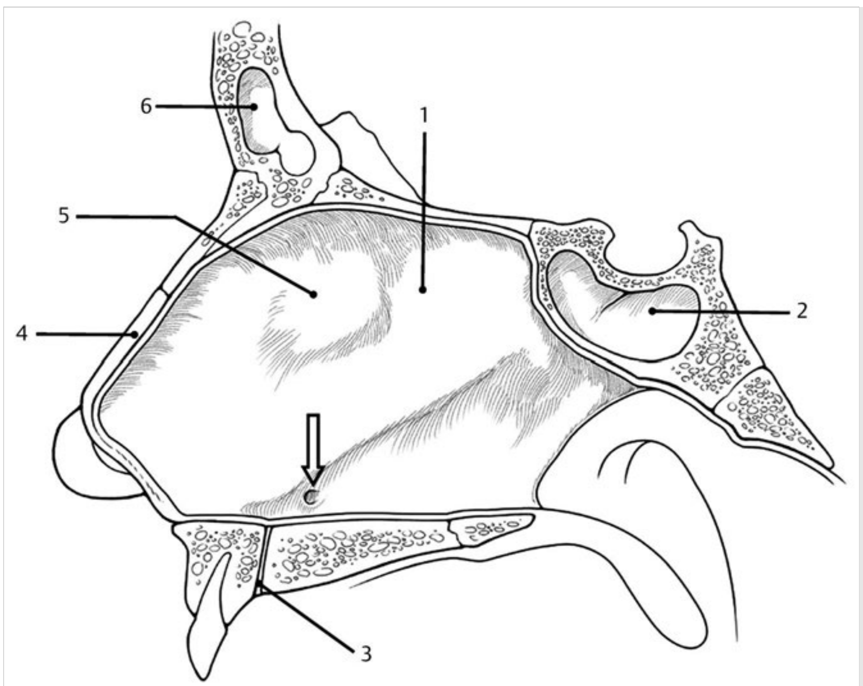

Fig. 1.7 Sagittal section through the facial skeleton with depiction of the nasal septum. The arrow points to the opening of the organon vomeronasale (Jacobson's organ). 1, nasal septum; 2, sphenoidal sinus; 3, incisive canal; 4, lateral nasal cartilage; 5 septal intumescentia; 6, frontal sinus.

was found in the median plane and the least underlap of 3.24 mm on the lateral margin of the lateral nasal cartilage. It should be noted, however, that there is a great variation in the connection between ULC and the nasal septum. Potter et al[15] observed only in 20% of cases a complete connection. Therefore, the caudal medial part of the ULC may show a free floppy segment that is not connected with the nasal septum. Taking into consideration that some nasal muscles (see later) are attached in this area, this construction may cause an additional unwanted mobility of the nasal valve area.

1.7.3 Paraseptal Cartilage

Lateral to the caudal part of the septal cartilage and below Jacobson's organ, a thin cartilage can be found, also known as paraseptal cartilage.[5,17] The two processes of the V-shaped cartilage may partially ossify.

1.8 Clinical Pathology of the Cartilaginous Pyramid

The most frequent pathologies include deviated nose syndromes (deviated pyramid, C- or S- shaped pyramid), hump nose, tension nose, saddle nose, and alar collapse syndrome. The understanding of this complex anatomy, the preoperative evaluation, and the precise surgical planning are the key in performing functional or aesthetic nasal surgery. There are various surgical techniques described in the literature to correct nasal pathologies. The desired surgical outcome should combine the two major characteristics of the external nose: rigidity and elasticity. The most frequently used surgical techniques include cartilage reshaping (septal repositioning, spreader grafts,[18] wedging, scoring, morselizing, suture techniques, tongue-in-groove technique, batten grafting) and cartilage reconstruction (extracorporeal resection[19] with or without polydioxanone foil,[20,21] use of conchal or rib cartilage[22]). According to the underlying pathology, a closed or open rhinoplasty approach can be chosen. Most of the surgical techniques can be done with a closed rhinoplasty, but cases with more severe pathology should be approached by an open technique, which allows better visualization and easier dissection.

1.8.1 Lobule

The lobule is made up of the two LLCs, connective and fatty tissue, and muscle fibers, and it is covered by thick skin with sebaceous glands. The subareas of the lobule are the tip, the alae, the columella, the nostril, and the vestibule. The tip of the nose consists of the supratip area ("the dip before the tip"), the tip defining points (most prominent areas of the domes producing light reflex), and the infratip area. The alae are the lateral walls of the nose and are made of, from inside to outside, the lateral crura of the LLC, muscles, and skin. Anatomically, the ala is divided into the alar rim, alar base, facet, vertical alar groove, supra-alar groove, and alar facial groove. The columella consists of the medial crura of the LLC. Important aesthetic features of the columella are the columella break and the midcolumellar groove (▶ Fig. 1.8, ▶ Fig. 1.9). The nostril is the orifice of the lobule. The vestibule is the skin-covered cavity between the nostril and the valve area.

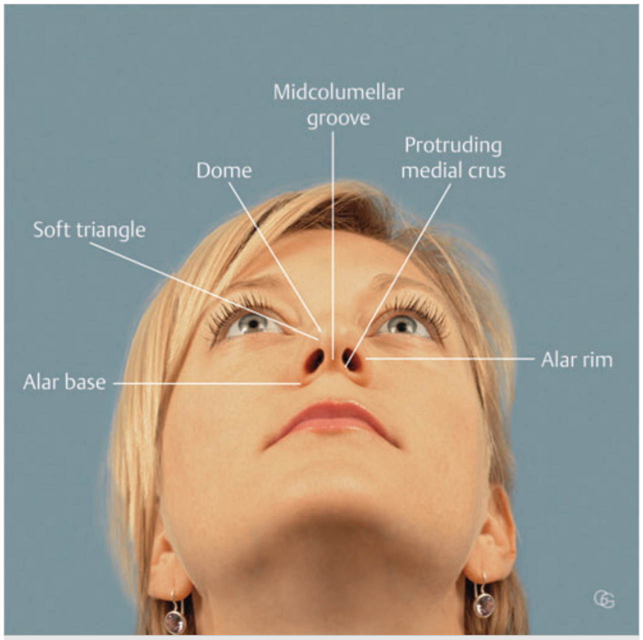

Fig. 1.8 Basal view of the lobule with major anatomic structures.

The LLCs are the cartilages that form the lobule and determine the form of the tip, alae, and columella (▶ Fig. 1.10). For surgical reasons, the alar cartilage is divided into the medial, intermediate (or middle), and lateral crura as well as the dome. The lateral crus is the lateral part of the LLC and varies in form. It can be convex, concave, convex-concave, or concave-convex. Its length varies from 16 to 30 mm and its height from 6 to 16 mm. The middle or intermediate crus is the anteriorly

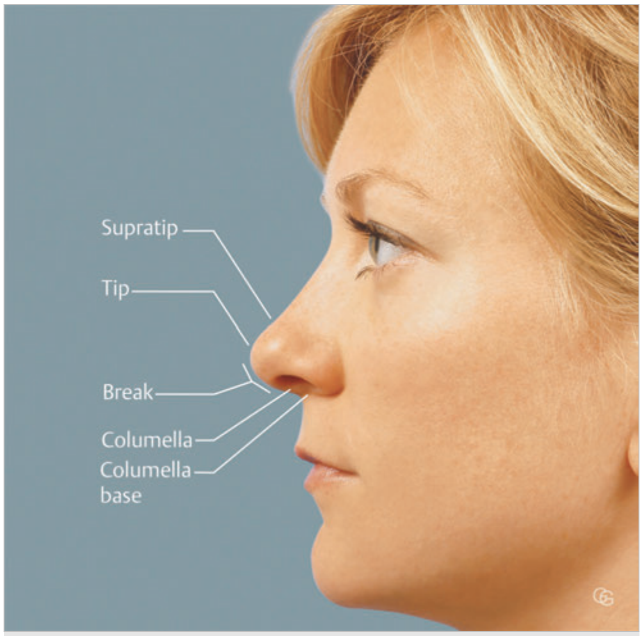

Fig. 1.9 Main structures of the lobule in the lateral view.

convex curved part that is composed of two segments, the upper domal segment and the antero-caudal lobular segment. The two domes together form the nasal tip. The medial crus is the medial part of the LLC. It forms together with the anterior lower part of the septal cartilage the columella. Like the middle crus, the medial crus is composed of two segments, the columellar segment and the footplate segment.[23] Whereas the columellar segment is vertically curved and continuously connected at the columellar-lobular junction to the lobular segment, the two footplate segments diverge to some extent. The inferior view of the columella reveals that both the paired columellar segments and the paired footplate segments of the medial crus diverge to some degree. Whereas the angle of domal divergence refers to the anterior divergence of the columellar segment, the angle of footplate divergence refers to the posterior divergence of the paired footplate segments.[23] There is a debate regarding the connection between the medial crus of LLC and the antero-caudal part of the septal cartilage (see later).

Even though the two LLCs tend to join, there is always a gap between the lower anterior margin of the septal cartilage and the medial side of the intermediate crus of the LLC, also known as weak triangle. There is a debate about the contents of this area. Whereas some researchers identified a well-organized dense fibrous tissue in this region, also known as interdomal ligament,[24,25] Han et al[26] found only loose tissue with a small amount of collagen and elastic fibers in the interdomal region. According to Copcu et al,[27] who studied 24 human cadavers, a well-developed interdomal fat pad (also known as domal fat body) was always detectable, also with ultrasonography.

1.8.2 Greater Alar Cartilage (Lower Lateral Cartilage)

The greater or major alar cartilages form the underlying structure of the nostrils (▶ Fig. 1.5, ▶ Fig. 1.10). In addition, they are the main components of the nasal tip. Each alar cartilage is composed of a medial, intermediate (middle), and a lateral crus that are curved around the naris. The medial crus is attached by fibrous tissue with the antero-caudal part of the septal cartilage, thus forming a part of the columella. Notably, Han et al[26] found no special tissue (neither loose nor dense connective tissue) between the medial crus and the anterior caudal part of the septal cartilage. The lateral crus usually overlaps the lower margin of the ULC. Most researchers found dense fibrous tissue connecting these two cartilages.[26,28] The alar scroll area is the interval structure between the lower and upper lateral cartilages. It is of great importance as it supports and gives form to the tip of the nose and provides rigidity to the internal nasal valve, thus playing an important role in the nasal function. In addition, dense fibrous tissue connects the lateral crus to the bony margin of the pyriform aperture.[26] According to new investigations,[29] a so-called pyriform ligament exists between the pyriform margin and the lateral cartilages. This area represents the lateral crural complex. The posterior border of the lateral crus is anchored to the frontal process of the maxilla by dense fibrous tissue and contains several small minor alar cartilages.[28] Because the lateral crus is too short to support completely the lower lateral part of the ala nasi, fibroareolar tissue fills the gap.

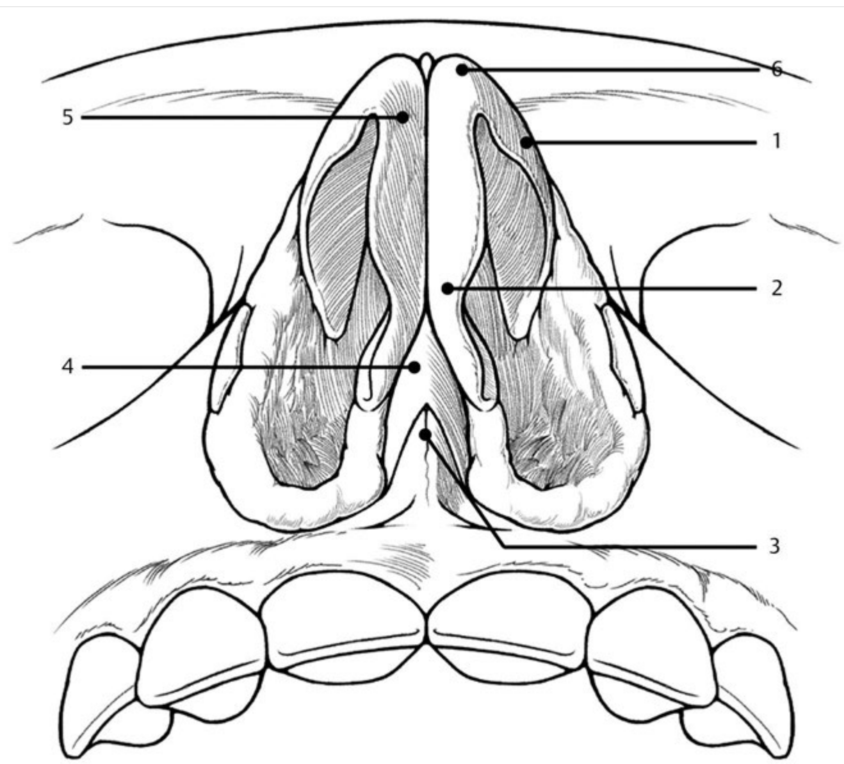

Fig. 1.10 Bony and cartilaginous framework of the external nose from an inferior view. 1, lateral crus of greater alar cartilage; 2, medial crus of greater alar cartilage; 3, anterior nasal spine; 4, septal cartilage; 5, middle (intermediate) crus of greater alar cartilage; 6, dome.

1.9 Soft Tissue Areas

The four soft tissue areas described in the literature have multiple terminologies. We support the terminology given by Huizing and de Groot[30]:

1. Paraseptal soft tissue area: A narrow triangular opening between the cartilaginous septum and the lower third of the medial margin of the ULC.
2. Lateral soft tissue area: The area between the lateral margin of the ULC and the lateral wall of the pyriform aperture.
3. Caudal lobular notch: The area medial to the lower margin of the lateral crus of the LLC also known as soft triangle or facet.
4. Alar soft tissue area: The most dorsal and caudal part of the ala, inferior to the lateral crus of the LLC.

1.10 Skin of the Nose

The thickness of the nasal skin varies considerably and depends largely on the number and distribution of sebaceous glands.[31] In the upper two thirds of the nose, which comprises the nasal dorsum and sidewalls, the skin is relatively thin and contains no sebaceous glands.[32] The caudal third of the nose shows a high number of sebaceous glands. In this area, the skin is thicker and closely connected to the muscles. Thus, the skin at the nasal tip and at the ala is rather thick. Nevertheless, it should be noted that the thickness of the nasal tip may also vary from thin to medium to thick.[33,34] This knowledge is of great importance when performing rhinoplasty. The dissection in the area should be precisely performed to prevent skin perforations and scarring.

1.11 Nasal Superficial Musculoaponeurotic System

The bony and cartilaginous framework of the external nose is covered by skin (see earlier) and the nasal superficial musculoaponeurotic system (SMAS).[24,25] The latter consists of up to five layers including (1) the skin, (2) the superficial areolar layer, (3) the fibromuscular layer, (4) the deep areolar layer, and (5) the perichondral/ periosteal layer.[25] The fibromuscular layer is composed of numerous muscles of facial expression, innervated by branches of the facial nerve. According to Saban et al,[25] the nasal SMAS covers the external nose continuously from the glabellar region to the lower margin of the nostrils. Because all nasal muscles are connected to each other by aponeuroses,[24,35] aesthetic rhinoplasty always has an impact on the whole nasal SMAS.

1.12 Nasal Muscles

There is an extensive literature about the nasal muscles.[16,24,35–37] In addition to the below-mentioned muscles, a great number of additional muscles have been described. Because most of the muscles of facial expression are interconnected to each other, facial motion can influence the motion of the nose.[38] To avoid any confusion, however, only the most common and clinically important nasal muscles are considered below. Within the nasal SMAS, the following muscles can be identified: M. procerus, M. levator labii superioris alaeque nasi, M. nasalis, M. depressor septi, M. dilatator naris, and M. apicis nasi (▶ Fig. 1.11).

1.12.1 Procerus

The procerus originates from the nasal bone and the lateral nasal cartilage and attaches within the skin of the glabellar region. It causes transverse wrinkles of the bridge of the nose. It is partially covered by medial muscle fibers of the orbicularis oculi muscle.

1.12.2 Levator Labii Superioris Alaeque Nasi

This muscle originates from the frontal process of the maxilla, medial to the origin of the lower part of the orbicularis oculi. In addition to the lip insertion (see below), some of the fibers are attached to the skin of the ala of the nose. Together with levator labii superioris and the zygomaticus minor, the levator labii superioris alaeque nasi is considered to be a direct tractor of the upper lip.[28] These direct tractors form a distinct continuous sheet of fibers that insert into the lip anterior to the orbicularis oris muscle. This muscle elevates both the lip and the ala nasi. Therefore, it is of great importance for dilating the nostrils.

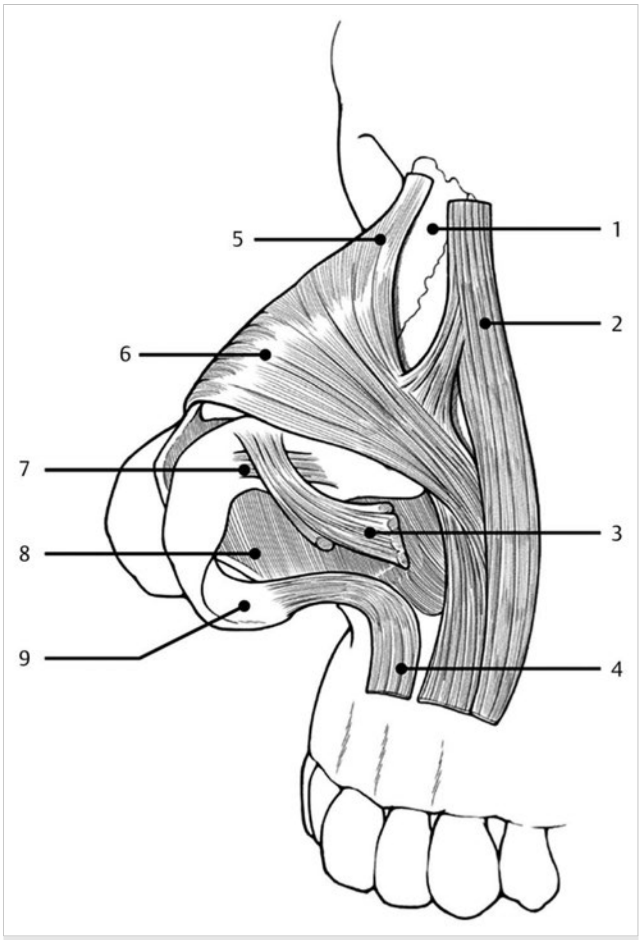

Fig. 1.11 Nasal muscles according to Bruintjes. 1, nasal bone; 2, M. levator labii superioris alaeque nasi; 3, M. dilatator naris; 4, M. depressor septi; 5, M. procerus; 6, M. nasalis, pars transversa; 7, M. apicis nasi; 8, nasal septum; 9, medial crus of greater alar cartilage.

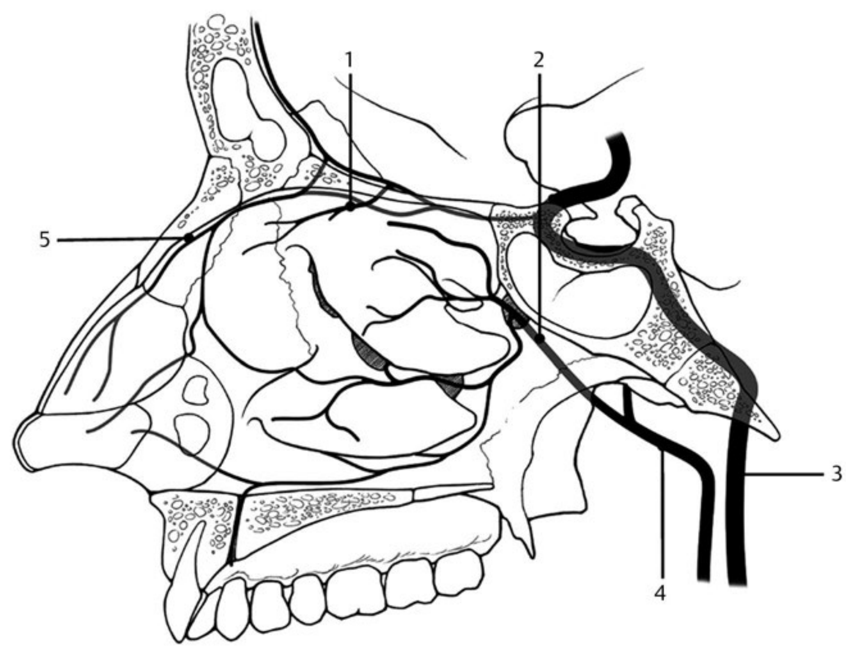

Fig. 1.12 Sagittal section through the facial skeleton with depiction of the arterial supply of the nasal cavity. 1, posterior ethmoidal artery; 2, sphenopalatine artery; 3, internal carotid artery; 4, external carotid artery; 5, anterior ethmoidal artery.

1.12.3 Nasalis

The nasalis muscle consists of two parts, a pars transversa and a pars alaris. The *transverse portion* originates from the canine ridge of the maxilla and inserts on the aponeurosis of the dorsum nasi together with its contralateral counterpart. According to Bruintjes et al,[35] the transverse part is not attached to the nose. The *alar portion* (dilatator naris posterior muscle) arises from the incisive fossa of the maxilla, above the lateral incisor. Its fibers run into the skin of ala nasi. Some of the fibers also insert into the nasal septum and the upper lip.[39] Whereas the alar part dilates the ala nasi, the transverse part serves to stabilize the nasal aperture at the valve area.[35]

1.12.4 Depressor Septi Nasi

This muscle arises from the maxilla above the central incisor, perhaps also from the anterior nasal spine,[24,37] and inserts into the membranous part of the nasal septum. Medial fascicles insert fan-shaped into the upper lip.[37] This muscle not only pulls down the medial crus of the greater alar cartilage but may also have an impact on widening the nostrils.[35]

1.12.5 M. Dilatator Naris

This muscle originates from the lateral crus of the greater alar cartilage and runs somewhat downwards to the alar skin. It may be considered as a dilator of the alar region.[27]

1.12.6 M. Apicis Nasi

This is a small muscle running from the lateral crus of the greater alar cartilage to the skin of the nasal tip without having significant functions.[35]

1.13 Blood Supply

According to Toriumi et al,[40] the most arterial, venous, and lymphatic vessels can be found within or slightly above the nasal SMAS.

The blood supply of the external nose arises mainly from branches of the facial and the ophthalmic arteries (▶ Fig. 1.12, ▶ Fig. 1.13). The facial artery gives rise to the superior labial artery, which divides into a septal nasal ramus and a lateral nasal ramus.[41] In some cases, the superior labial artery is connected to the infraorbital artery.[41] The superior labial artery is the main vessel supplying the nasal tip region.[42] Further branches for the nasal tip are the dorsal nasal artery (ophthalmic artery) and some columellar branches (inferior alar ramus, facial artery) of small diameter.[40,42] The anterior ethmoidal artery gives off a branch that runs through a small foramen on the dorsum nasi.[5]

Veins can be found laterally along the lateral side of the nose, usually beneath the nasal SMAS in the submuscular areolar tissue.[40] The venous drainage from the external nose runs from the external nasal veins both to the angular vein and further to the superior ophthalmic vein or the facial vein. Venous valves exist throughout the facial region, suggesting a well-directed venous blood flow.[43] Of special importance is the possible drainage toward the angular vein and the pterygoid plexus.

1.14 Lymphatics

The lymph at the region of the pyriform aperture drains within the subcutaneous fatty tissue or beneath the SMAS toward the facial vein and further to the sub-mandibular lymph nodes.[5] Lymphoscintigraphic studies on the nasal tip of patients revealed drainage toward the lateral crura of the nose and further to the preparotid lymph nodes.[40] There is obviously no

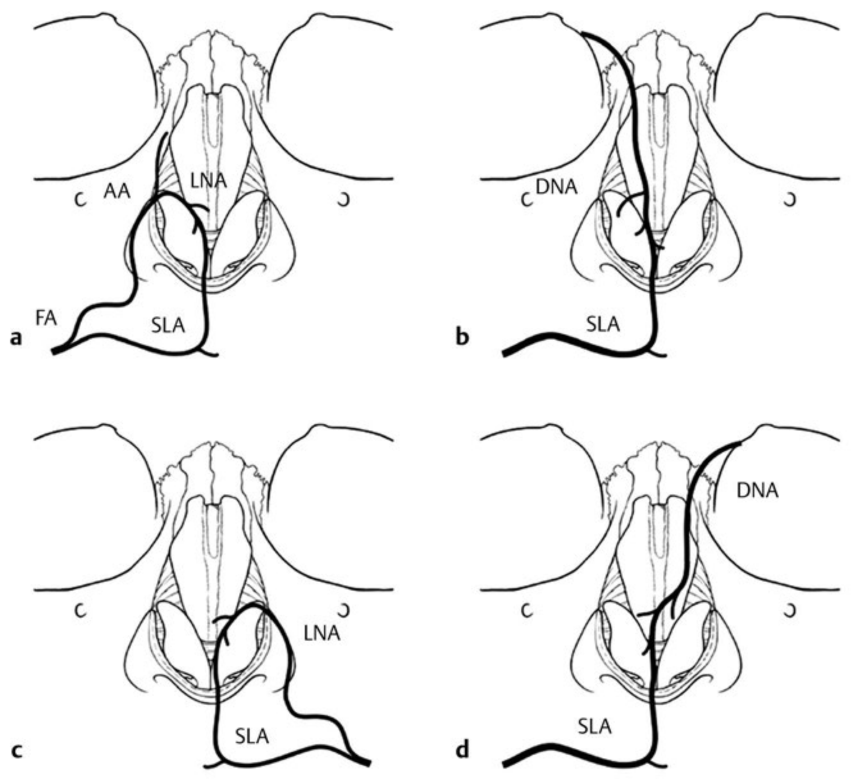

Fig. 1.13 Variation in the distribution of arteries at the nasal tip after Jung et al: (**a**) type I; (**b**) type II; (**c**) type III; (**d**) type IV. FA, facial artery; AA, angular artery; LNA, lateral nasal artery; DNA, dorsal nasal artery; SLA, superior labial artery.

lymphatic drainage down the columella. The root of the nose and the lateral part of the dorsum of the nose drain in close proximity to the inferior margin of the orbital cavity toward the lymph nodes at the parotid gland, sometimes along buccal lymph nodes.[5]

1.15 Nerves

Like most parts of the human facial region, the external nose is innervated by branches of the trigeminal nerve, especially by branches of the ophthalmic and maxillary nerves (▶ Fig. 1.14).

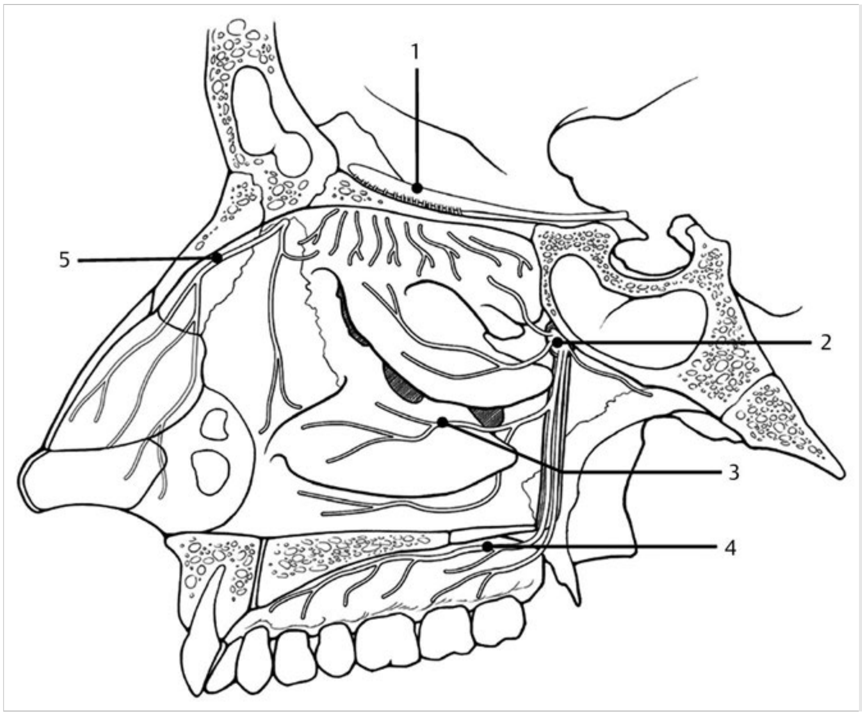

Fig. 1.14 Sagittal section through the facial skeleton with depiction of the innervation pattern of the nasal cavity. 1, olfactory bulb; 2, pterygopalatine ganglion; 3, nasal branches; 4, greater palatine nerve; 5, external nasal nerve.

Whereas the nerve supply of the radix nasi consists of supratrochlear nerve, the dorsum nasi is innervated by the infratrochlear nerve and the external ramus of the anterior ethmoidal nerve (external nasal nerve). This external nasal nerve passes usually through the nasal bone beneath the nasal SMAS toward the apex of the nostril.[44] It may run as a single branch or divide into several small branches.[44] The alar region is supplied by branches of the infraorbital nerve of the maxillary nerve. Another nerve of the nose that should be definitely mentioned is the incisive nerve, which runs through the incisive canal. It passes through the incisive canal together with the incisive artery and supplies the incisive teeth. The dissection in this region, cm posterior to the anterior nasal spine, should be done with care to avoid complications, such as sensibility dysfunctions, of the hard palate and color alterations of devitalized incisive teeth.

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2 The Effect of Facial Asymmetry on Nasal Deviation

Richard W. Westreich, David Burstein, and Marika Fraser

2.1 Introduction

Facial growth and development is a complex process in which multiple independent structures interact at various stages to produce a unified form. This progression occurs over a person's entire life, with the majority of changes determined in the embryological, childhood, and adolescent periods. Involutional changes continue to occur with advancing age, resulting in issues such as senile nasal tip ptosis and nasal collapse.

The aesthetic definition of the nose as an anatomic structure is inherently linked to those structures that surround it. Modification of these structures, such as the midface, can greatly affect not only the appearance of the nose but also its function. The embryological origin of the nose is a complex combination of contributions of the frontal prominence, the merged medial nasal prominences, the lateral nasal prominences, and the cartilage nasal capsule.

Within this context, it is reasonable to conclude that nasal form and function can be affected by asymmetries in the underlying facial skeleton and soft tissue envelope. A nose that develops on an uneven facial platform may grow in a deviated fashion. This may produce various amounts of nasal obstruction, depending on the degree of deviation and the underlying genetically programmed nasal anatomy. Anecdotally, many patients relate new-onset nasal deviations during adolescence, typically a period of robust nasal growth.

Nasal surgeons have routinely accepted that facial asymmetry has a role in nasal deviation, the most startling and obvious example being patients with cleft lip and palate. For many decades, the classic pattern seen in those patients has been extrapolated to patients without facial clefts. The senior author has previously investigated this hypothesis and found it to be untrue.[1]

The literature surrounding facial asymmetry is sparse. Recently, there appears to be a renewed interest in this concept, and several authors have shown significant associations between nasal deviation and asymmetries of the face.[2–4] Although conventional wisdom has previously looked at hemifacial asymmetries, there appears to be emerging evidence that discrete zonal facial hypoplasia can occur and can exist across a spectrum of severity.

Previous descriptions of hypoplasia in relation to the nose have included brow height discrepancies, dystopic lateral canthi, retracted ala, nasal deviation, commissure asymmetry, and deviation of the mentum. However, not all patients have upper, middle, and lower facial asymmetries that fit into this hemifacial pattern. Additionally, not all descriptions are in agreement as to whether an affected area is higher, lower, retracted, and so on.

The concept of zonal hypoplasia is not a new one, as it has been considered in the dental and oral surgery literature for some time.[5,6] Mandibular hypoplasia often results in occlusive deformities, for which patients commonly seek orthodontic or surgical correction. Associated deviation of the mentum and vertical mandibular height discrepancies are often seen. These underlying bony abnormalities result in surface cosmetic issues that are corrected with orthognathic surgery. This includes not only mandibular symmetry but also mentum position and lip line cant or commissure asymmetry. Binder and Azizzadeh have previously discussed malar asymmetry or hypoplasia as it relates to involutional changes in the midface with advancing age.[7]

2.2 Embryology of Nasal Development

The nose originates from a complex combination of contributions. The frontal prominence forms the bridge, the merged medial nasal prominences form the median ridge and tip of nose, the lateral nasal prominences forms the alae, and the cartilage nasal capsule forms the septum and the nasal conchae.[8] A complex interplay of feedback inhibition and cellular communication orchestrates the relative growth and development of these structures into a final form.

During development at the third week of gestation, neural crest cells complete their caudal migration toward the midface. The frontonasal process migrates inferiorly and differentiates into two projections known as the nasal placodes. These nasal placodes will ultimately incorporate ectoderm and mesenchyme as they fuse to become the nasal cavity and primitive choana. The primitive choana forms the point of development of the posterior pharyngeal wall and the various paranasal sinuses.

The surrounding tissues are converted to olfactory pits, which indent the frontonasal process and divide it into a medial and two lateral nasal processes. The rounded lateral angles of the medial process constitute the globular processes of His. The olfactory pits form the rudiments of the nasal cavities, and from their ectodermal lining the epithelium of the nasal cavities, with the exception of that of the inferior meatus, is derived.[9]

The globular processes elongate posteriorly as plates, termed the nasal laminae. These laminae are at first some distance apart, but ultimately fuse and form the nasal septum; the processes themselves meet in the midline to form the premaxilla and the philtrum. The depressed part of the medial nasal process between the globular processes forms the lower part of the nasal septum or columella. Above this, a prominent angle becomes the future apex of the nasal tip, and more cephalically, the future bridge of the nose is formed. The paired lateral nasal processes converge to form the alae of the nose.

The external nares approach each other as the frontonasal process becomes narrower and its deep part forms the nasal septum. Mesoderm becomes heaped up in the median plane to form the prominence of the nose. Simultaneously, a groove appears between the region of the nose and the bulging forebrain. As the nose becomes prominent, the external nares come to open downward instead of forward.[8]

The oronasal membrane, which is fully formed by the end of fifth week of development, gives rise to the floor of the nose. The palate later develops from this membrane. The continuing growth of the embryo brings both the nasal placodes and the maxillary processes together in midline to form the maxilla and the beginning of the external nose. The frontonasal prominence gives rise to an inferior mesodermic projection, which goes on to form the nasal septum dividing the nose into two cavities.[10] At any stage in this complex process, growth asymmetry or retardation has the potential to create zonal areas of hypoplasia that may ultimately become relevant for nasal positioning.

2.3 Cleft Lip Model of Nasal Deviation

Unilateral cleft lip and palate is a classic example of how facial asymmetry leads to nasal deviation. The well-described and relatively consistent pattern of nasal deformity seen in these patients is likely a result of both the asymmetric bony base that supports the nose and the unbalanced biomechanical forces acting on the nose. Certainly, there is maxillary hypoplasia and abnormal positioning of the lateral maxillary segment on the side with the cleft deformity, which results in a posterolateral displacement of the piriform rim and alar base. In addition, anomalous muscular and ligamentous insertions create atypical and uneven forces on the nasal cartilage, bone, and soft tissues.[11,12]

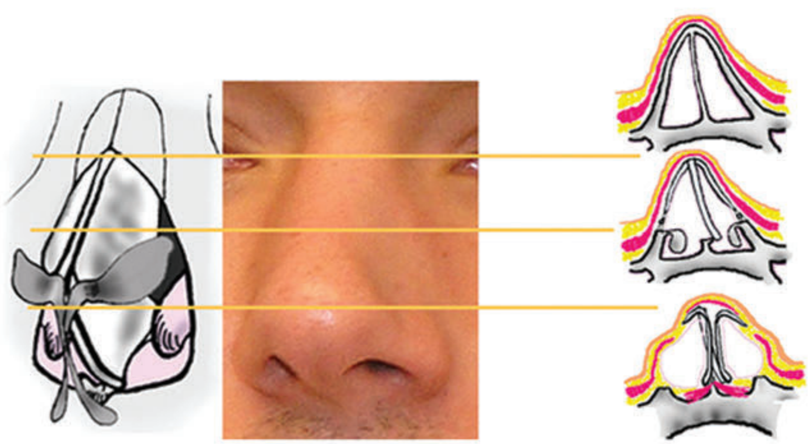
The most striking features of the cleft lip nasal deformity involve the septum and nasal tip. As a midline structure, the nasal septum is typically exposed to equal opposing forces from both sides of the face. In a normal situation, the septopremaxillary ligament attaches the anterior septum to the premaxilla, and the orbicularis oris inserts into the anteroinferior septum and nasal spine bilaterally. When there is a cleft, these insertions are disrupted unilaterally, and the caudal septum is pulled to the noncleft side by the unopposed forces. Posteriorly, bowing and deviation of the cartilaginous and bony septum toward the cleft side cause considerable obstruction.

The nasal tip cartilages and soft tissues are secondarily deformed by the underlying facial malformations. On the noncleft side, the orbicularis exerts force on the columella and contributes to the septocolumellar deviation away from the cleft. On the cleft side, orbicularis oris inserts into the alar base and pulls it laterally and inferiorly; the alar base also assumes a more posterior position on this side due to the underlying hypoplastic maxilla. The pull of orbicularis on the lateral crus of the lower lateral cartilage creates a lateral crural steal effect. Though the lower lateral cartilage is the same size as on the opposite side, the medial crus is shortened, the lateral crus is elongated, and the dome is flattened with a more obtuse angle. The nostril then appears widened and horizontally oriented.[13]

2.4 Zonal Model of Nasal Deviation

The cantilever model for nasal tip biomechanics represents an extension of the original tripod theory that incorporates several new concepts into predicting nasal tip position after surgery.[14] The model takes into consideration the elastic potential energy of the cartilage and helps to explain why certain maneuvers project or rotate the nose. Modifications to the nasal tip cartilages generally produce an upward force vector, which is stored in the paired tip cartilages as elastic potential energy. This energy is balanced by gravitational and isometric forces that are derived from the surrounding supporting elements of the face and nose. Of particular importance is the frontal process of the maxilla, as it has a role in tip, upper lateral cartilage, and nasal bone stabilization. The push and pull of these force vectors determine the ultimate position of the nasal tip after modification maneuvers in a craniocaudal direction. However, the balance of these forces will also determine nasal position along a mediolateral vector.

A simplification of these surrounding force elements is to view the nose as a series of successive triangles, each with a central supporting element (that determines projection, height, and stability) and lateral stabilizing elements that determine midline positioning.[1] The lateral stabilization is provided either through isometric contact between adjacent structures (i.e., upper and lower lateral cartilages at the scroll region) or direct fibrous sesamoid complex or bony attachments (nasomaxillary suture line; ▶ Fig. 2.1).



Support Elements

Central	Lateral
Bony septum	Nasal bones Frontal process
Cartilaginous septum	Upper lateral cartilage Frontal process
Caudal septum Columellar complex	Lower lateral cartilage Alar soft tissue Frontal process

Fig. 2.1 Cross-sectional schematic of the upper, middle, and lower thirds of the nose in the setting of right maxillary deficiency. The effect of a retrusive medial maxilla is seen throughout the different regions of the nose. Despite relatively equal development of the nasal suprastructure, a significant linear external deviation is seen in all areas of the nose. (Reprinted with permission from Archives of Facial Plastic Surgery 2009; 11(3):157–164. Copyright (2009) American Medical Association. All rights reserved.[1])

If one views the upper, middle, and lower thirds of the nose in this light, it is easy to see how projection deficiencies in the maxilla could result in a deviation to that segment. If the upper, middle, and lower aspects of the medial maxilla are hypoplastic, then the entire nose will often lean off toward that side.

When viewing the face and its relationship to the nose, the most critical vector of hypoplasia would therefore be the anteroposterior height of the medial maxillary buttress. This is essentially the frontal process of the maxilla. Deficiency in this region results in nasal deviation toward the hypoplastic side.

Typically, if the anteroposterior vector is deficient, then the other vectors of the maxilla will be deficient as well (craniocaudal and mediolateral). This should ultimately result in lowering of the orbit, flattening of the zygoma, and superior ascent of the commissure on the side of maxillary hypoplasia. A pattern then emerges where these four findings are often but not exclusively seen together. These abnormalities also exist along a continuum where subtle differences may only be seen after strict photographic analysis (▶ Fig. 2.2, ▶ Fig. 2.3).

Although mandibular and frontal bone hypoplasia can coexist with maxillary hypoplasia, it is not absolutely required. There structures are derived from different processes during embryological development and can independently develop in a symmetrical manner. Findings often cited, such as a higher eyebrow or chin deviation toward the side of hypoplasia, are again sometimes but not always associated with midfacial hypoplasia and nasal deviation (▶ Fig. 2.4).[2,15]

Multiple investigators have tried to quantify methods of analyzing facial asymmetry. Most oral surgery studies have found significant issues related to deviation of the mentum or lip line cant from the horizontal.[5,6] This likely reflects a selection bias to some degree. Plastic surgery and facial plastic surgery literature often neglects analysis of the lower facial one-third. Chatrath et al showed an association with the perception of facial asymmetry and disparities in the lateral excursion of the ala off the midline.[3] Hafezi et al showed an association between clinically asymmetric faces and nasal deviation.[2] To date, we have not found a relevant analysis of the upper facial third.

The study by Hafezi et al demonstrated maxillary hypoplasia in association with nasal deviation by viewing photographs of 671 patients who underwent cosmetic nasal surgery.[2] They found a strong relationship between "crooked noses and facial growth retardation." A total of 153 patients were identified as asymmetric. These patients were subdivided into three groups: those with deviated noses and asymmetric faces (57.5%), deviated noses with normal faces (24.8%), and asymmetric faces with straight noses (17.6%).

Their analysis utilized measurements between the lateral canthus and mouth corner as well as the distance between the rhinion to the most lateral cheek projecting point. In essence, these frontal views measured the craniocaudal and mediolateral or transverse maxillary vectors but did not assess the anteroposterior vector. These measurements were compared with the patient's normal side.

Fig. 2.2 Congenital facial asymmetry with nasal deviation. Pre- and postoperative photographs showing deviation correction using foundation rhinoplasty techniques alone.

Fig. 2.3 Nasal deviation in the setting of midfacial and upper facial zonal hypoplasia. Pre- and postoperative views of a combined foundation rhinoplasty and cosmetic rhinoplasty approach.

Fig. 2.4 Midfacial and mandibular facial asymmetry with nasal deviation. Foundation rhinoplasty alone without nasal bone osteotomy provided airway correction. The patient did not desire cosmetic correction but did want airway straightening. Persistent right midvault asymmetry due to partial onlay graft resorption is present. The patient did not desire additional corrective maneuvers and was pleased with the outcome.

Significant differences were noted in those individuals with nasal deviation and facial asymmetry in several of the measured parameters. Vertical height differences (lateral canthus to mouth corner) were greater in those patients with deviated noses and asymmetric faces than those with midline noses and asymmetric faces.

There was an even higher degree of association between the lateral or transverse measurements (rhinion to lateral cheek point) than the vertical one. This is not surprising because commissure position is also affected by mandibular development and is not specifically dependent on maxillary volume. This echoes other investigations, which have shown lateral alar displacement to be the most significant anatomic issue in nasal deviation and the perception of facial asymmetry. Overall, 76% of their patients with facial asymmetry had nasal deviation, and only 26% had midline noses ($p < 0.05$).

Another important finding within this study was the high rate of revision (28%) in the 88 patients with both nasal deviation and facial asymmetry. A significant number of those patients had also had orthodontic interventions during their lifetime (57/61 questionnaire respondents). A 72% satisfaction rate was noted within this group of respondents. Causes of dissatisfaction included persistent deviation, asymmetric nostrils, and asymmetric alar rims.

Chatrath et al assessed frontal photography of 300 patients requesting rhinoplasty surgery; 234 patients were identified as having facial asymmetry.[3] Comparison of various soft tissue points on the face to the vertical midline facial meridian was done. Lateral alar, medial canthus, and lateral canthus excursion was noted to be a significant predictor of the face as asymmetric. Commissure deviation and tragal height differences were not noted to be predictive.

A follow-up study by the same group of authors was done for those patients who had undergone rhinoplasty correction.[4] They found a significant correlation between rhinoplasty surgery and objective improvement in these measurements. They reported a subjective improvement in the perception of facial asymmetry in these patients as well.

A previous study by Yao et al used base view analysis of patients with nasal deviation and facial hypoplasia.[1] Measurements of nasal deviation on frontal view were compared with angulation of the alar attachment to the face on base view. A nearly linear association was seen ($R = 0.8$) between these two measurement points, indicating a high degree of correlation. This base-view soft tissue analysis indirectly looks at the anteroposterior maxillary volume (▶ Fig. 2.5, ▶ Fig. 2.6).[1]

Fig. 2.5 Typical measurements taken before and after foundation and aesthetic rhinoplasty correction. Deviation correction can only be taken as far as the face will accommodate. Note the starting nasal point between the pupils and the tip position essentially at the philtrum (vertical lines). Postoperatively, an improved but persistent nasal axis deviation is present (horizontal lines).

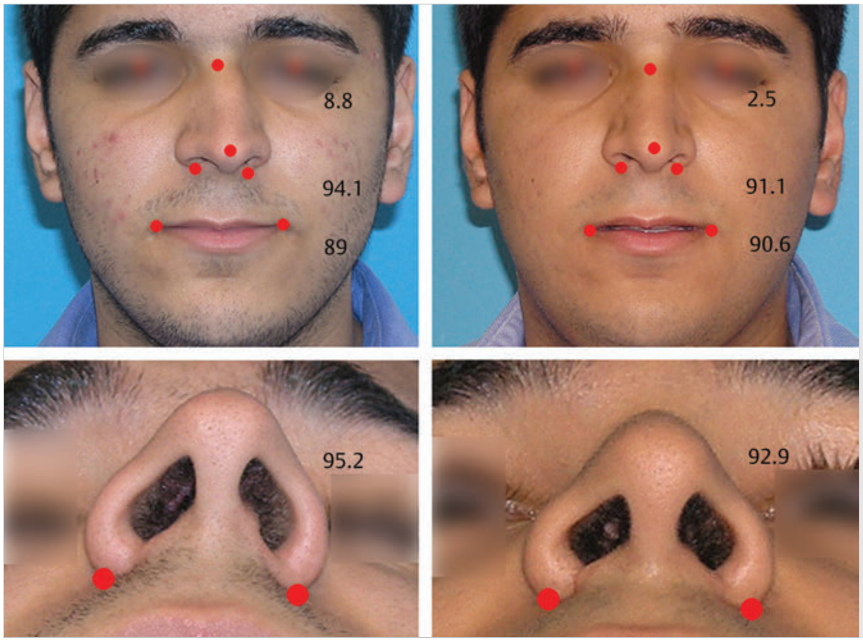


Fig. 2.6 Typical pre- and postoperative measurements in patient with isolated zonal midfacial asymmetry. Note the increased deviation correction and alignment of facial structures on the vertical plane compared with the patient in ▶ Fig. 2.4

It becomes clear that a zonal view of the facial skeleton that separates the face into thirds and also considers the three-dimensional development of each segment emerges. Any one area or vector can be deficient in isolation, but typically the entire maxilla is hypoplastic. With respect to the nose, it is the medial maxillary projection that matters most. This theory could be investigated using computer tomography and volume analysis as answering this question could further our understanding of nasal and facial development.

2.5 Linear Versus Curvilinear Nasal Deformities

As a surgeon becomes more experienced with nasal corrective procedures, certain patterns of deformity typically become internalized into the individual physician's thought process and surgical treatment plan. Drawing upon past patient experiences helps one to define corrective maneuvers that will work and those that will not. Analogy from patient to patient then occurs and, as more patients fit within that mold, a surgeon can begin to recognize patterns of anatomic variation. The nose is no exception.

The senior author has had significant experience correcting deviated noses for both functional and cosmetic reasons. Within the context of this experience, a pattern for congenital nasal deviation associated with midfacial hypoplasia has developed and, although not exclusive, represents a starting point for developing a surgical plan for deviation correction.

Congenitally deviated noses are typically linear, but traumatically deviated noses are typically curvilinear. A linear deviation, which is almost exclusively seen with midfacial hypoplasia, is one in which the following anatomic variations are seen:

- Nasal bone deviates toward the hypoplastic side.
- Dorsal septal deviates toward the hypoplastic side.
- Posterior septal deflects off the maxillary crest. This propagates as a vomerine spur with bony septal deviation toward the normal side. The caudal septum may traverse the crest to ultimately lie on the side of tip deviation (ipsilateral) or remain on the same side (contralateral) as the deeper dislocation.
- Nasal tip deviates toward the hypoplastic side.
- Dome lateralization on the hypoplastic lower lateral cartilage is evident.
- Vertical cephalic lower lateral cartilage is hypertrophied on the hypoplastic side with convexity compared with the opposite lower lateral cartilage (▶ Fig. 2.7).

Several significant variations may be seen in these patients. Significant difficulties arise with asymmetric development of the anterior nasal spine. The position of the anterior nasal spine should be determined preoperatively and verified intraoperatively. If the spine lies in a paramedian position, then deviation correction must be done using a method that transposes the posterior septal angle to the opposite side of the spine, rather than on top of it.[16] An alternate approach is to remove the paramedian portion of the crest and leave a remnant in a midline position. This is only possible with bifid crests that are a few millimeters off midline. The surgeon should also be aware of the increased potential for postoperative deprojection, unless columellar strut placement is part of the operative protocol. The degree of deviation correction with paramedian crests, in the senior author's experience, is also harder to achieve and predict.

Another significant variation is seen in patients with midline nasal bones. Deviation correction does not mandate osteotomies, as corrective maneuvers of the lower nasal two-thirds are reliably predictable in this circumstance (▶ Fig. 2.8).

The congenital deviation stands in contradistinction to the traumatically deviated nose, where curvilinear deformities are typically present. Deviation is typically most pronounced at the rhinion due

Fig. 2.7 Congenital deviation with midline nasal bones and ipsilateral caudal deflection. Combined foundation and cosmetic rhinoplasty outcome shown.

Fig. 2.8 Linear congenital nasal deviation with midline bones and ipsilateral caudal septal positioning. Pre- and postoperative views of foundation rhinoplasty correction without nasal bone osteotomy or suture tip modification.

to nasal bone fracture, and septal dislocation worsens toward the junction of the bony and cartilaginous septum. The tip typically is only slightly off midline due to tractional pull from the caudal septum, and base view analysis does not show significant angulation of the alar attachments to the face. The overall effect creates the appearance of a curved nose, due to the relatively midline tip position. These patients also do not typically have maxillary crest and vomerine spurs associated with the deviation unless the trauma occurred in childhood (▶ Fig. 2.9, ▶ Fig. 2.10).

Fig. 2.9 Typical isolated traumatic deviation. Deviation is predominantly located at the rhinion. Although septal dislocation, midvault asymmetry, and torsional displacement of the nasal tip are seen, the nature of the underlying anatomic asymmetries within the cartilaginous nose is different. The base view demonstrates an absence of angulation of the alar attachments to the face, which is indicative of symmetric midfacial development.

2.6 Traumatic Facial Asymmetry

The nasal bones are the most commonly fractured bones in the face[4] and thus are a leading cause of an asymmetric nose. Facial injuries may lead to surface depressions, irregularities, and disruption of the traditional nasal support mechanism, which may or may not cause nasal deviation and/or dysfunction. Nasal collapse may occur from upper lateral cartilage avulsion or warping. Septal dislocations may create new-onset nasal airway asymmetry, which causes functional obstructive symptoms.

Patients with severe facial injuries, typically as a result of high-speed automobile accidents or Lefort I fractures, can develop traumatic nasal tip deviation. Loss of lateral supporting elements of the maxilla exerts its effect upon the nasal tip through the sesamoid complex and intervening fibrofatty tissue. This pulls the nasal tip offline. Volume addition to the lateral pyriform rim or subalar region can result in significant tip medialization in these patients (▶ Fig. 2.11).

In contradistinction, patients with tripod fractures or isolated zygomatic arch fractures do not typically have changes to the position of the nasal tip.

2.7 Psychology of Nasal Deviation and Facial Asymmetry

The psychological focus on nasal and facial form has been present for centuries. Symmetry of facial features is a significant factor in the perception of beauty and health. The nose, as the central feature of the face, is likely the most important element that can alter the perception of symmetry. Many theories, including the nasogenital reflex, among other nasal reflex neuroses, have been proposed. The nose has been implicated in determining sexual preference.[17] Several recent studies have demonstrated the central role of the nose in a patient's perception of the face as symmetric.[3,4] The converse has also been shown to be true after corrective nasal surgery.

Many newer studies on quality of life and nasal surgery have shown a less esoteric but persistent impact of the nose on a patient's overall psychological health.[18] The concept of averageness and symmetry was also recently investigated by Komori et al.[19] They found a gender difference in the relative importance of facial symmetry on the determination of beauty. Surprisingly, male faces were affected by the presence or absence of symmetry, but female faces were not. Both male and female patients had improvements in beauty scores when the face was within an average of normal, as compared with composite faces. Having distinct features (not lying within normal facial norms) had a negative impact on attractiveness in both men and women.

A study by Ishii et al objectively measured the attentional bias to peripheral facial deformities by tracking observers' eye movements as they looked at frontal photos.[20] In addition to demonstrating increased attention to facial irregularities, they showed that observers scan new faces in a predictable pattern that focuses their gaze on the eyes, nose, and mouth, the so-called central triangle of discriminating features.

It is reasonable to assume that in the absence of noticeable peripheral deformities, any asymmetry of these central features