State of the Art in Secondary Cleft Rhinoplasty: Comprehensive Technical Details and Deformity-Specific Approach

22

Rafael Denadai and Lun-Jou Lo

Contents

Abstract

The secondary cleft nasal deformity presents a challenge for the surgeon devoted to deliver high-level longitudinal cleft care. The underlying complex anatomic deformities combined with scarring from a needed primary rhinoplasty make the secondary cleft rhinoplasty a challenging procedure, with no consensus about a single surgical approach to fully address the multilayered abnormality (skin, cartilage, vestibular lining, and skeletal base platform). This chapter addresses the surgical approach to the secondary cleft nasal deformity after skeletal maturity, highlighting the abnormalities of unilateral and bilateral cleft nasal deformities and its surgical treatment aiming nasal symmetry from the top-down with definition and straightening of the nasal dorsum, adjustment of the nasal tip (rotation, projection, definition, and length), proper alar base repositioning, and improvement of nasal airway functioning. Multiple surgical techniques, that is, component nasal dorsum reduction, nasal dorsum argumentation, septoplasty, spreader flaps, spreader grafts, columellar strut graft, septal extension graft, cephalic trim, nasal tip suturing methods, tip grafts, alar base

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mobilization, nasal osteotomy, and inferior turbinate reduction, are also reviewed.

Keywords

Cleft nasal deformity · Secondary cleft rhinoplasty · Cleft

22.1 Introduction

The cleft nasal deformity presents a challenge for the surgeon devoted in delivering high-level longitudinal cleft care. Many surgeons of subsequent generations were concerned that any nasal dissection at the time of primary lip repair could compromise subsequent cartilage growth. However, this misconception has been noticeably dismissed (Seo et al. 2019, 2020). Therefore, all efforts are currently focused on maximizing nasal outcomes at the time of primary cleft lip repair. One key element of the longitudinal care provided to patients with a cleft lip and nose deformity is to address the primary nasal deformity at the time of primary cleft lip repair (Lo 2006). Surgeons continue to discuss whether any surgical intervention versus a closed procedure versus a septal and nasal tip procedure should be performed concomitantly with primary cleft lip repair. It is the authors' standard practice to perform primary rhinoplasty with overcorrection (Lo 2006; Lonic et al. 2016; Chang et al. 2018; Denadai et al. 2020a, b, 2021b; Denadai and Lo 2020; Jung et al. 2020; Murali et al. 2021; Chung and Lo 2021, 2018) to eliminate or attenuate the need for intermediate rhinoplasty during the growing period (see Chaps. 10 and 12) as the motto of this book: *Moving Toward Excellence of Outcome and Reducing the Burden of Care*. Moreover, this primary nasal overcorrection operation (Lo 2006; Lonic et al. 2016; Chang et al. 2018; Denadai et al. 2020a, b, 2021b; Denadai and Lo 2020; Jung et al. 2020; Murali et al. 2021; Chung and Lo 2021, 2018) aims at reduction of the psychosocial consequences of an otherwise uncorrected (and stigmatizing) cleft nose deformity. Importantly, it does not necessarily eliminate the need for a future operation at skeletal maturity, which is the focus of this chapter.

In the literature, intermediate cleft rhinoplasty has often been performed during growing age to address a severe nasal deformity (residual or iatrogenic abnormalities) or a nasal deformity-derived psychosocial distress (Wang and Madorsky 1999; Shih and Sykes 2002; Lo et al. 2002; Cho and Baik 2001; Cho 2007; Bae et al. 2013; McDaniel et al. 2013; Gary and Sykes 2016; Kim et al. 2016; DeFazio et al. 2018; Ayeroff et al. 2019; Chouairi et al. 2020). It has been described different moments for intermediate cleft rhinoplasty with or without concomitant revisionary cleft lip repair whenever the child is under general anesthesia for other indications (Wang and Madorsky 1999; Shih and Sykes 2002; Lo et al. 2002; Cho and Baik 2001; Cho 2007; Bae et al. 2013; McDaniel et al. 2013; Gary and Sykes 2016; Kim et al. 2016; DeFazio et al. 2018; Ayeroff et al. 2019; Chouairi et al. 2020) (Fig. 22.1):

- Preschool age (age 4–6 years), if a surgical intervention is needed for velopharyngeal insufficiency or Eustachian tube dysfunction-related problem;
- School age (6–9 years), if a surgical intervention is needed for a Eustachian tube dysfunction-related problem;
- Middle school age (9–12 years; mixed dentition), at the time of the secondary alveolar bone grafting.

Despite the success of a primary rhinoplasty with or without an intermediate rhinoplasty, a considerable proportion of patients will still require a secondary cleft rhinoplasty (also called definitive or final rhinoplasty) for the management of a secondary nasal deformity (from minor to major) at skeletal maturity (above 15 years and 18 years in females and males, respectively) (Fig. 22.2). Patients with secondary cleft nose deformity should properly be treated to attenuate the burden from psychological pressures of nasal deformities (aesthetic and functional shortcomings).

Cleft nose repair is challenging because of the complexity of a three-dimensional deformity involving several structures such as the lower lateral cartilages, upper lateral cartilages (pair of triangular structures), the columella, the nasal dorsum, the nasal septum (quadrangular cartilage), and the elements of skeletal framework. The incidence of secondary cleft nasal deformity plus variability in its clinical presentation has yielded several available surgical techniques and maneuvers, with advantages and disadvantages of each particular method; but still, there is no consensus on an optimal surgical approach to manage all of the secondary cleft nose deformity-related problems. There is no cookie-cutter resolution to this problem. The proper clinical diagnosis of misplaced nasal anatomy allows the establishment of a deformity-specified surgical plan with the appropriate selection of logical surgical maneuvers.

This chapter addresses the surgical approach of the secondary cleft nasal deformity at skeletal maturity, highlighting the abnormalities of unilateral and bilateral cleft nasal deformities and its surgical treatment aiming nasal symmetry with a proper definition of the nasal dorsum, tip, and base and improvement of nasal airway functioning. An overview of surgical technical details is also provided.

22.2 Understanding the Cleft Nose Deformity

Cleft nasal deformity is existent in all forms of cleft lip with or without a cleft palate. The degree of primary nasal abnormality generally parallels the severity of cleft lip: complete cleft lip > incomplete cleft lip > lesser-form cleft lip. Even in

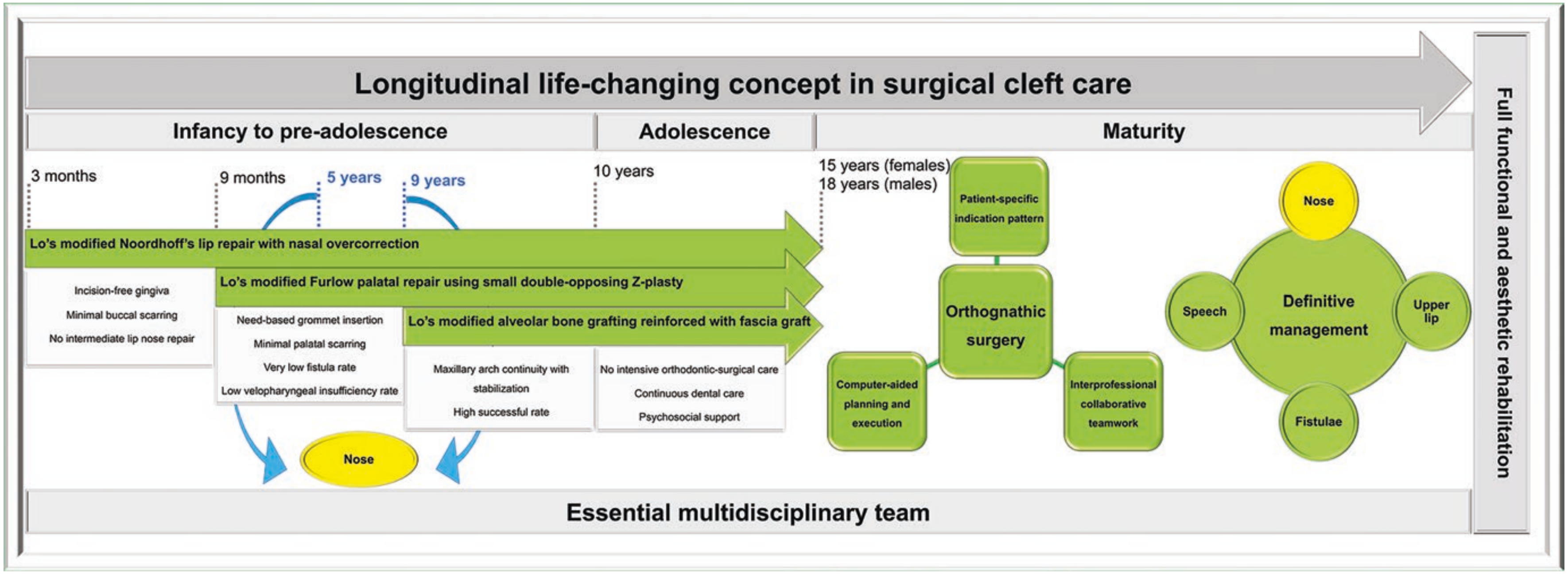

Fig. 22.1 When a nasal-focused surgical intervention could not be avoided based on performance of an effective primary rhinoplasty, the management of a residual cleft nasal deformity is fitted within the longitudinal follow-up, with surgical therapy indicated (if possible) concomitantly with other surgical intervention (e.g., lip revision, speech surgery, secondary alveolar bone grafting, surgical intervention for Eustachian tube dysfunction-related problem) to reduce the total number of surgical interventions. (Adapted from: Denadai R, Lo LJ. Toward reducing the surgical burden of care: Modern longitudinal life-changing concept in cleft care. J Formos Med Assoc. 2020;119(6):1013–1015. doi: https://doi.org/10.1016/j.jfma.2019.10.017)

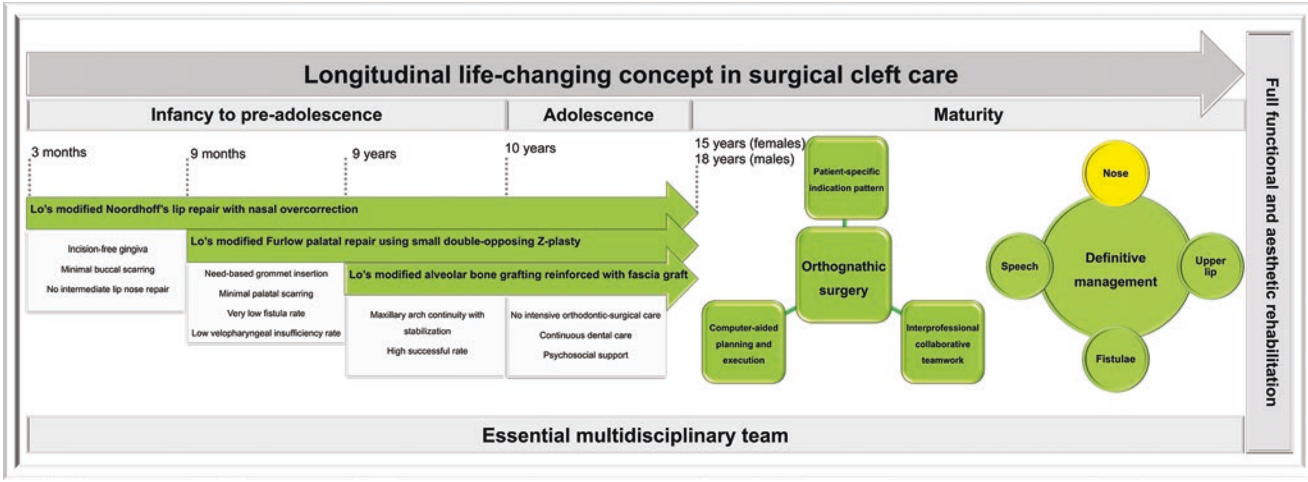

Fig. 22.2 Based on key evolutionary lessons learned and outcome-based research, the cleft management protocol has successfully evolved over the time, with establishment of current state-of-the-art protocol to achieve excellence in cleft care by delivering a balanced functional and esthetic outcome. Secondary cleft rhinoplasty is performed at 9 years of age. (Adapted from: Denadai R, Lo LJ. Toward reducing the surgical burden of care: Modern longitudinal life-changing concept in cleft care. J Formos Med Assoc. 2020;119(6):1013–1015. doi: https://doi.org/10.1016/j.jfma.2019.10.017)

a lesser-form cleft lip deformity, there is a nasal abnormality. The characteristics of primary rhinoplasty-derived residual deformity including undercorrection, relapse, and/or unintended technical error-derived result; or basically ignoring the primary nasal abnormality during cleft lip repair, and scarring process plus nasal growth-induced nasal distortions determinate a complex cleft nasal deformity (named as secondary cleft nose deformity) at skeletal maturity. The clinical findings of a secondary cleft nose deformity vary on the type and severity of the cleft (unilateral or bilateral; complete, incomplete, or lesser form), the surgical technique of primary repair, and nasal distortions that happen with the scarring process and nasal growth (Ahuja 2001; Byrd et al. 2007a; Guyuron 2008; Fisher et al. 2014; Allori and Mulliken 2017; Rohrich et al. 2021). To properly reconstruct a secondary cleft nose deformity, surgeons should initially recognize each particular abnormality (Fig. 22.3) and its potential effect on nasal functioning.

In a unilateral cleft nose deformity (Fig. 22.4), the ala on the cleft side rests on an underdeveloped maxilla, contributing to alar base lowering, depression and horizontal nostril seating. The cleft-side ala could be weak and exhibit a convoluted shape, with an additional contribution to the lowering of cleft dome (the dome angle is the angle created at the domes between the medial crura and lateral crura of the lower lateral cartilage). Functional failure of the external valve on cleft side could be secondary to mispositioning of the alar base, misbalancing of muscular pull, and abnormal attachment of the cheek-originated muscles to the lateral crus. Tip projection could be further compromised by a shortened columella that could be obliquely deviated to the noncleft side. Deviation could affect both bone and the cartilaginous elements of the nose. The caudal septum plus the anterior nasal spine could be deviated from the facial midline to the noncleft side. Both the cartilaginous mid-septum and the osseous posterior septum, that is, the perpendicular plate of the ethmoid bone, could be deviated toward the cleft side; this combined bone and cartilaginous abnormality could produce a complex C-shaped deformity both craniocaudally and anteroposteriorly. The deviation of the cartilaginous septum toward the cleft side could also narrow and enlarge the airway (cross-sectional area) on the cleft and noncleft sides, respectively. The deviated cartilaginous septum could also result in turbinate hypertrophy on the noncleft side. The nasal bones could be widened both at the dorsum and at the frontal process of the maxilla. A mid-vault curvature could also be present with collapse on the concave side and fullness on the convex side.

The bilateral secondary cleft lip nose deformity (Fig. 22.5) in patients with a repaired bilateral cleft lip with or without cleft palate tend to present with nasal abnormalities prominent but less asymmetrical (e.g., flat and broad nasal tip, flat nasal ala, displaced alar bases, and short columella) than a unilateral secondary cleft lip nose deformity because the deforming forces on each side of the nose (complete or incomplete on both sides) are in balance. For asymmetrical bilateral cleft lip or forms with protruded and deviated premaxilla, the nasal abnormalities could, more often, be asymmetrical, that is, close to that of a unilateral cleft lip. The septum is coincident with the facial midline; when any deviation of septum is present, it is usually deviated caudally toward the less involved side. Characteristically, major nasal

Fig. 22.3 Denadai and Lo's interpretation for surgical-focused diagnosis of unilateral and bilateral cleft nasal deformity. For further details refer to Figs. 22.4 and 22.5

<table>
<tr><th></th><th>Unilateral cleft nasal deformity</th><th>Bilateral cleft nasal deformity</th></tr>
<tr><td>Nasal dorsum</td><td>Minor widening; irregular and asymmetric dorsal aesthetic line; deviation (toward noncleft side)</td><td>Moderate widening
Midline</td></tr>
<tr><td>Alar root</td><td colspan="2">Inferiorly & posteriorly displaced</td></tr>
<tr><td>Alar base</td><td colspan="2">Wide (displaced laterally, posteriorly, and inferiorly)</td></tr>
<tr><td>Nasal tip</td><td>Asymmetry
Lack of projection and definition</td><td>Flat, broad, weak tip projection</td></tr>
<tr><td>Columella</td><td>Short hemicolumella
Deviated (toward noncleft side)</td><td>Short bilaterally
Wide base</td></tr>
<tr><td>Nostril</td><td colspan="2">Flattened
Obliquely oriented</td></tr>
<tr><td>Vestibule</td><td colspan="2">Web</td></tr>
<tr><td>Septum</td><td>Deviated anterocaudal (toward noncleft side)
Deviated posterior (toward cleft side)</td><td>Anterocaudal (midline)
Posterior (variable deviation)</td></tr>
<tr><td>Inferior turbinate</td><td>Hypertrophied</td><td>Variable hypertrophy</td></tr>
<tr><td>Skeletal framework</td><td colspan="2">Maxillary hypoplasia & retrusion (Class III malocclusion)</td></tr>
</table>

abnormalities have been described in mature patients with bilateral cleft lip:

- Pseudo hump
- Deficiency of the nasal tip projection and definition
- Wide nostrils
- Lateralized and caudally rotated alar bases
- Short columella

A recent long-term analysis appraised three-dimensional nasal morphometry (ten linear, four angular, six proportional, one surface area, and one volume parameter)

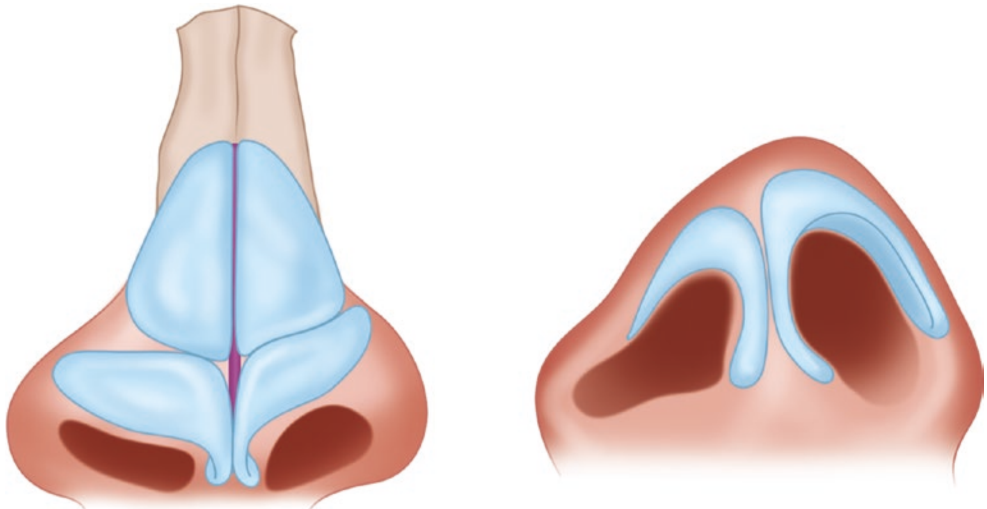

Fig. 22.4 Unilateral cleft nose deformity (Modified with permission from Rafael Denadai, MD)

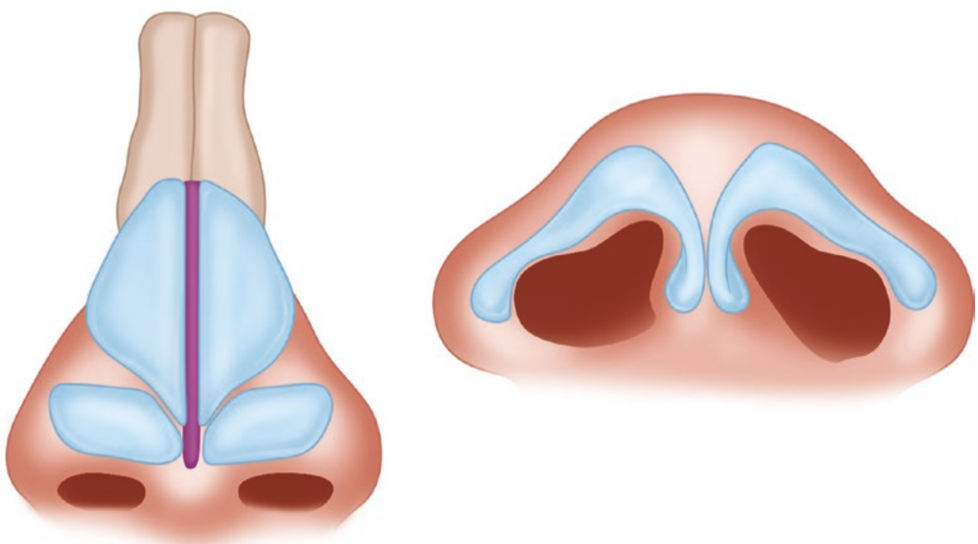

Fig. 22.5 Bilateral secondary cleft deformity (Modified with permission from Rafael Denadai, MD)

of patients with unilateral cleft lip and palate who underwent primary rhinoplasty (Noordhoff approach) by the senior author between 1995 and 2002 and reached skeletal maturity ($n = 52$; mean age at data collection of 19 ± 1 year) but had not received orthognathic surgery at data collection period (Seo et al. 2020). This cleft cohort displayed significantly (all $p < 0.05$) lower nasal bridge length and nasal tip projection, and greater nasal protrusion, tip/midline deviation, nasal tip angle, nasal tip protrusion width index, and alar width/mouth ratio values than the healthy age-, sex-, and ethnicity-matched subjects (control group, $n = 52$). No significant differences (all $p > 0.05$) were observed for the remaining measures, including nasal height, alar width, nasal dorsum angle, columellar angle, columellar-labial angle, nasal tip/height ratio, nasal index, alar width/intercanthal distance ratio, nasal surface area, and nasal volume (Seo et al. 2020). These findings reveal a residual cleft nose deformity after primary rhinoplasty characterized by insufficient nasal tip projection (short nasal bridge length, small nasal tip projection, and large nasal tip angle) due to nasal tip deviation (large nasal protrusion, large tip/midline deviation, and large nasal tip protrusion width index). The significant difference in alar width/mouth width ratio could be clinically secondary to a narrow mouth width after primary cleft lip repair, which is confirmed by the absence of significant differences in alar width/intercanthal distance ratio.

A recent study assessed three-dimensional long-term nasal morphometry (ten linear, four angular, six proportional, one surface area, and one volume parameter) in patients with bilateral cleft lip and palate who underwent primary rhinoplasty by the senior author between 1995 and 2002 and reached skeletal maturity ($n = 39$; mean age at data collection of 19 ± 2 years) but had not received orthognathic surgery at data collection period (Seo et al. 2019). Healthy age-, gender-, and ethnicity-matched subjects ($n = 52$) were enrolled for comparative analyses. Among the patients with bilateral cleft lip and palate, males had significantly (all $p < 0.05$) greater nasal bridge length, nasal height, nasal protrusion, alar width, nasal tip projection, columellar height, dome height, nasal surface area, and nasal volume than females, with no significant differences in the remaining measurement parameters. Skeletally mature patients with bilateral cleft lip and palate who underwent primary rhinoplasty presented with significantly (all $p < 0.05$) smaller nasal tip projection and nasal tip angles, but greater values for nasal dorsum length, nasal protrusion, alar width, columellar height, dome height, columellar angle, labiocolumellar angle, nasal tip height ratio, nasal index, alar width/intercanthal distance ratio, and alar width/mouth width ratio compared to healthy subjects. There were no differences (all $p > 0.05$) in nasal height, tip/midline deviation, nasal dorsum angle, dome-to-columella ratio, columella height/alar width ratio, area surface, and volume parameters between the two groups (Seo et al. 2019). Based on these findings (Seo et al. 2019), skeletally mature patients with bilateral cleft lip and palate present with four main clinical differences compared to healthy individuals:

- Inappropriate columella (greater columellar height and similar dome-to-columella ratio)
- Cephalic rotation of the nasal tip (smaller columella angle and nasal bridge length and greater columellar–labial angle, nasal protrusion, and nasal tip height ratio)
- Insufficient nasal tip projection (smaller nasal tip projection and greater nasal tip angle)
- Greater alar parameters (greater alar width, alar width/intercanthal distance ratio, alar width/mouth width ratio, and nasal index)

Caudal attachment of the columella base to the premaxilla and scarring process after primary repair resulting in a downward drift of the columella base could explain the cephalic rotation of the nasal tip; inadequate repositioning of lower lateral cartilages during the primary or intermediate rhinoplasty interventions could result in insufficient nasal tip projection and greater alar width; and the greater alar width feature could also be secondary to the presence of a narrow mouth width as a consequence of adopting the lateral lip elements to reconstruct medial structures during primary cleft lip repair (Seo et al. 2019).

A further three-dimensional morphometry-based nose outcome study encompassed patients with class III skeletal pattern and congenital cleft lip palate deformity ($n = 23$) or developmental dentofacial deformity ($n = 23$) after (>12 months) three-dimensional computer-assisted single-splint two-jaw orthognathic surgery (Denadai et al. 2020c). Healthy age-, gender-, and ethnicity-matched subjects were included for comparison. The cleft cohort had significantly ($p < 0.001$) smaller nasal length, nasal tip projection, and columellar angle and greater nasal protrusion, alar width, and columellar-labial angle values than the dentofacial and healthy cohorts, with no significant differences between the dentofacial versus healthy cohorts (Denadai et al. 2020c). Overall, patients with cleft deformity demonstrated three main dissimilarities to the dentofacial and healthy cohorts from a clinical standpoint:

- Cephalic rotation of the nasal tip (smaller columella angle and nasal length and greater columellar–labial angle and nasal protrusion)
- Insufficient nasal tip projection (smaller nasal tip projection)
- Greater alar width

Overall, the morphometry-based nose outcome data (Ferrario et al. 2003; Seo et al. 2019, 2020; Denadai et al. 2020c; Harrison et al. 2020; Maliha et al. 2020) reinforced that mature patients with a cleft deformity could show nasal morphological differences than healthy individuals, regardless of primary rhinoplasty or surgical management of the skeletal framework. The described findings of residual nasal deformities (Seo et al. 2019, 2020; Harrison et al. 2020; Maliha et al. 2020; Denadai et al. 2020c) should be truly contemplated for the planning of secondary cleft rhinoplasty at maturity, with the founding of deformity-specific strategies.

22.3 History

Historically, many surgeons have proposed technical maneuvers to manage a cleft nasal deformity (Spira et al. 1970).

Gillies and Kilner (1932) presented a superior advancement of the composite chondrocutaneous hemicolumella flap by adopting a midcolumellar incision. Gillies and Kilner (1932) also presented correction of the bilateral cleft nose using a VY advancement of the prolabium and the columella towards the tip. McIndoe (1938) was the first to adopt cartilage repositioning and fixation to treat a cleft nasal deformity. Cronin (1958) presented a technique to lengthen the columella in a bilateral cleft lip deformity using the elevation of bipedicled flaps of the nasal floor-based medially on the columella and laterally on the alae. Converse (1964) replaced the mid-columellar incision with a marginal incision, with the medial crura composite flap advanced superiorly and sutured to the contralateral dome, and the defect at the columella base repaired with an auricular composite graft procedure. Potter (1946) adopted a lateral-to-medial advancement of the lateral crural composite chondrocutaneous flap, with the resultant defect at the lateral vestibular skin closed in a V-to-Y fashion. Berkeley (1959) presented maximum exposure and suture fixation of the lower lateral cartilages. McComb (1975) described a superior buccal sulcus approach for mobilization of the cleft side lower lateral cartilage and undermining of the skin from the nostril margin up to the nasion.

Tajima and Maruyama (1977) described the reverse-U incision to address both obliteration of the soft triangle and nostril apex overhanging. The reverse-U incision starts inferomedially at the junction of the columella and membranous septum, continues superiorly onto the depressed dome skin, and returns into the mucosa of the nostril. This reverse-U incision creates an arc similar to the shape of the nostril on the noncleft side. After careful dissection of the nasal skin envelope, the lower lateral cartilages are properly repositioned with suturing maneuvers, including suture from the cleft side lower lateral cartilage to the ipsilateral upper lateral cartilage, suture from cleft side lower lateral cartilage to contralateral upper lateral cartilages, and suture from cleft side lower lateral cartilage to the contralateral lower lateral cartilage. The excess skin in the nostril apex is rolled upward and into the nostril, with the closure of the skin creating a high-positioned soft triangle on the cleft side.

Dibbell (1982) adopted an incision within the nostril rim plus excision of soft tissue to address medial rotation of the lower lateral cartilage, lateral displacement of the alar base, twisting of the domes, columellar asymmetry, and overhang of the ala on the cleft side. Blackwell et al. (1985) described an onlay cartilage graft using bilateral marginal and intercartilaginous incisions to access the lower lateral cartilages.

Lo et al. (2003) revisited the Abbé flap by managing the bilateral cleft lip nasal deformity with simultaneous use of the Abbé flap and open rhinoplasty in selected patients with tight upper lip, short prolabium, lack of acceptable philtral column and Cupid's bow definition, central vermilion deficiency, irregular lip scars, and associated nasal deformity. Bilateral cleft nose deformities require repositioning of both lower lateral cartilages. The goal for the correction of a secondary bilateral cleft lip nasal deformity is to decrease the angle of divergence between the domal points of the lower lateral cartilages, create a more defined nasal tip, and provide a strong nasal framework for better tip projection. If the cartilages are not strong enough to allow for appropriate tip projection using suturing techniques, structural grafts can be helpful. The Abbé flap was designed 13–14 mm in length and 8–9 mm in width, containing full-thickness tissue from the central lower lip and a slightly narrow reverse-V caudal end. The prolabium, scars, and central vermilion were excised, with preservation of part of the prolabial skin to elongate the columella, if indicated. An open rhinoplasty approach was performed with or without cartilage graft for columella and nasal tip reconstruction. Reduction of the alar width and nostrils was achieved by a Z-plasty or excision of scar tissue at the nostril floor. The results demonstrated no flap problems or perioperative complications. Seven of 39 patients needed minor revisions on the nose and/or lip. The patients were satisfied with the final result, with acceptable lower lip scars (Lo et al. 2003).

Multiple other surgical techniques have been described for secondary rhinoplasty, including incision-, suture-, flap-, and cartilage graft-derived surgical maneuvers techniques (Rohrich et al. 2021; Okawachi et al. 2020; Liu et al. 2020; Zhou et al. 2020; Park et al. 2020; Oommen et al. 2019; Wolfe et al. 2016; Basta et al. 2014; Hwang et al. 2012; Masuoka et al. 2012; Kaufman et al. 2012; Bashir et al. 2011; Chang et al. 2011; Flores et al. 2009; Sakamoto et al. 2014; Turkaslan et al. 2008; Guyuron 2008; Stal and Hollier 2002; Wei et al. 2017; Han et al. 2017; Nakamura et al. 2016, 2011; Park 2014; Fujimoto et al. 2011; Zbar and Canady 2011; Kim et al. 2008; Garri et al. 2005; Cho et al. 2002; Foda and Bassyouni 2000; Sàndor and Ylikontiola 2006; Han and Choi 2001; Koh and Eom 1999; Sertel et al. 2017; Pagan et al. 2021; Jenny et al. 2021; Sharma et al. 2021; Hantawornchaikit et al. 2021; Ren et al. 2021; Hoshal et al. 2020; Zhang et al. 2020, 2021; Chen et al. 2018; Stark et al. 2020; Cohen 2019; Picard et al. 2019; Talaat et al. 2019; Hsieh et al. 2018, 2017; Kehrer et al. 2019; Vass et al. 2016; Cuzalina and Tolomeo 2021; Cuzalina and Jung 2016; Pawar and Wang 2014; Yuan et al. 2018; Rothermel et al. 2020; van Zijl et al. 2018; Moore et al. 2020; An et al. 2021; Na and Jang 2020; Wong et al. 2017; Tiong et al. 2014; Won and Jin 2012; Huang and Liu 2012; Jin and Won 2016, 2011; Kim and Daniel 2012; Jayaratne et al. 2014; Jang and Yi 2014; Jang and Alfanta 2014; Lee and Song 2015; Moon and Han 2018; Jang 2018; Lao et al. 2021).

22.4 Surgical-Focused Diagnosis of Nasal Deformity

Meticulous preoperative clinical analysis lays the foundation for a successful surgical outcome. To build an accurate surgical-focused diagnosis of a secondary cleft nose deformity or an untouched nasal deformity (i.e., patients who were initially treated elsewhere with no primary rhinoplasty), a detailed clinical analysis (careful clinical assessment with the observation of the patient's frontal, lateral, and basal nasal views, palpation, and anterior rhinoscopy) should be performed. If indicated, nasal endoscopy and computed tomographic scan could be arranged contributing to clarify the specific anatomical and dysmorphological pattern as well as to compose a patient-specific surgical plan with a deformity-customized surgical approach (Fig. 22.6).

Nasometry could offer objective information on obstructed nasal airflow; however, it is needless for the regular clinical diagnosis of nasal airway obstruction.

Different nasal elements (Figs. 22.7, 22.8, and 22.9), that is, skin, cartilage, vestibular lining, and skeletal platform (nasal pyramid, perpendicular plate of the ethmoid bone, and maxillary segments) (Banks 1983; Ahuja 2001; Byrd et al. 2007a; Agarwal and Chandra 2007; Woodard and Park 2010; Lee et al. 2011a, b; Agarwal et al. 2012; Fisher et al. 2014; Sowder et al. 2017; Allori and Mulliken 2017; Brito et al. 2020), should judiciously be considered in this clinical analysis, spanning a wide spectrum of severity in patients with a secondary cleft nasal deformity. Comprehensive and systematic preoperative nasofacial analysis should consider different but complementary nasofacial elements:

- Nasofrontal angle acute or obtuse
- Nasolabial angle: acute or obtuse
- Facial proportions: height (thirds; hairline-glabella-nasal base-menton), width (fifths), asymmetry
- Nasal length: long or short (distance from radix to nasal tip)
- Skin: quality, thickness, and Fitzpatrick type
- Nasal dorsum: deviation from midline (C-, reverse C-, S-shaped deviation)

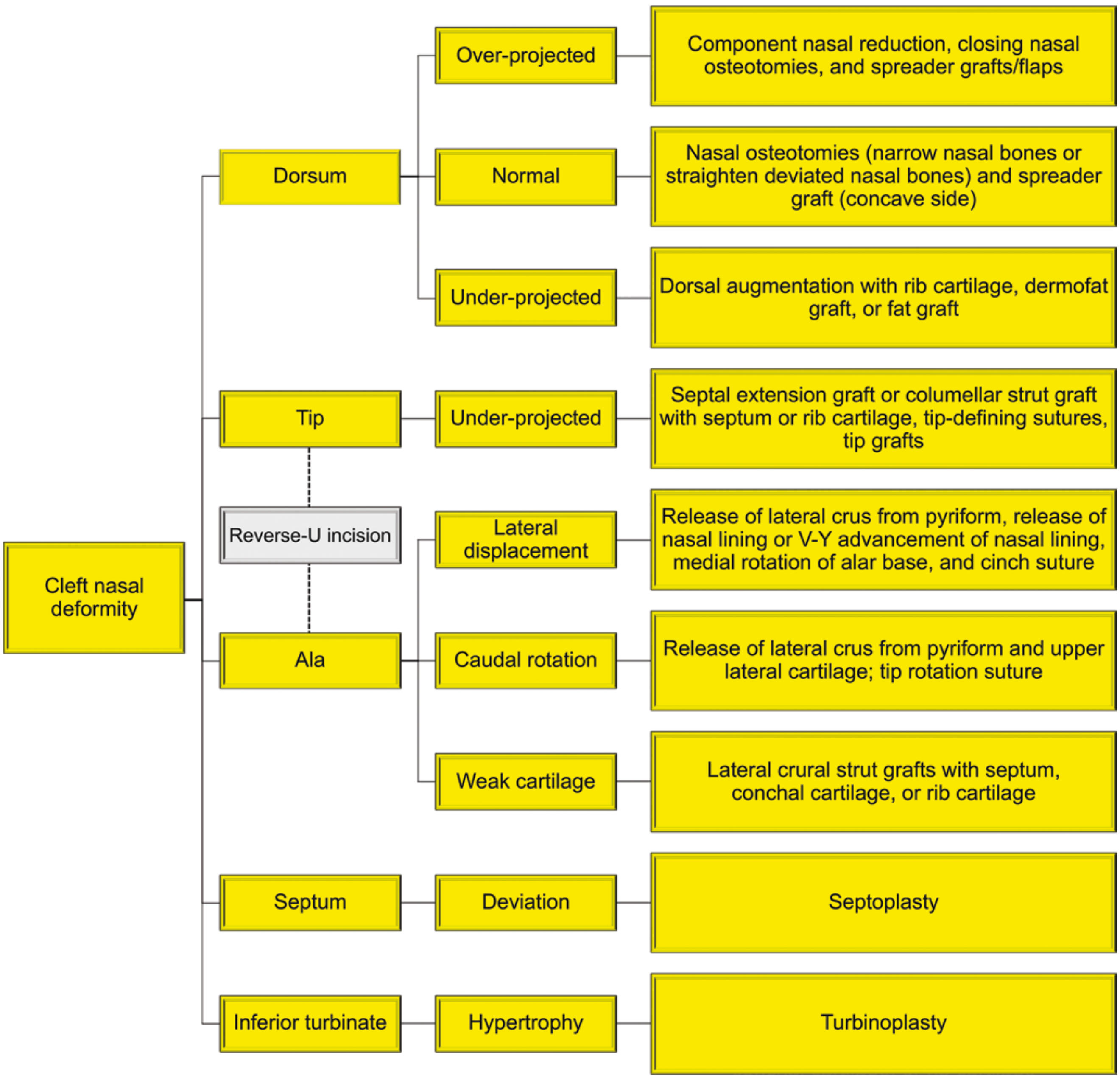

Fig. 22.6 Denadai and Lo's interpretation for surgical tactics for secondary cleft rhinoplasty

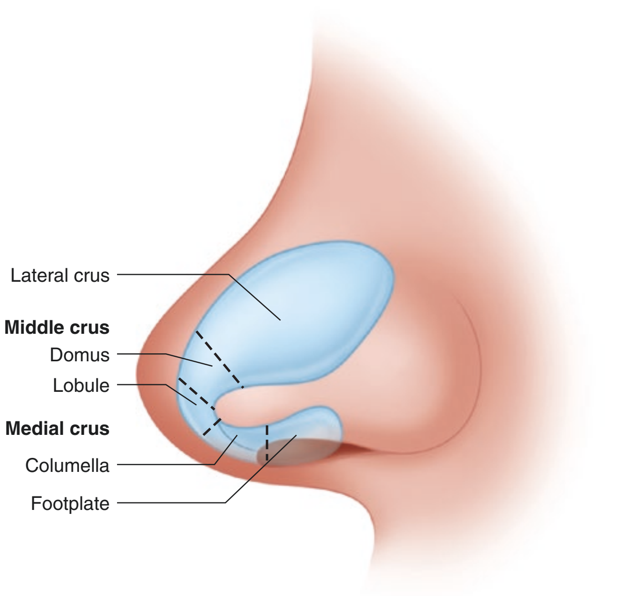

Fig. 22.7 Lower lateral cartilage (Modified with permission from Rafael Denadai, MD)

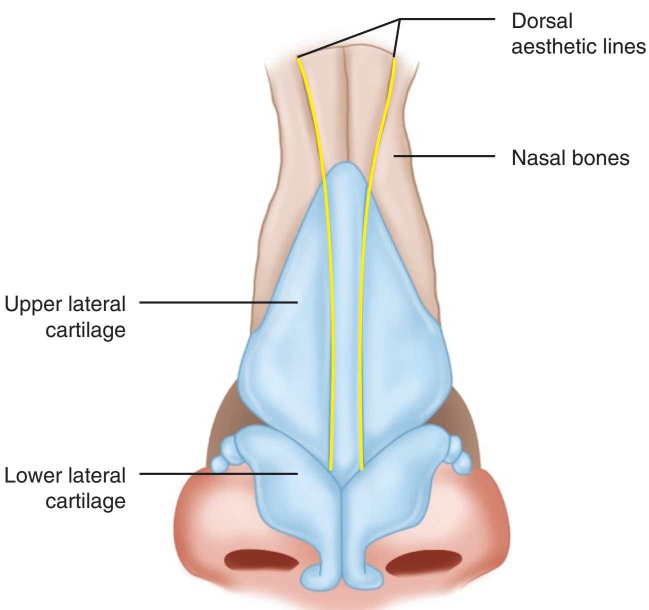

Fig. 22.8 Nasal cartilages, nasal bones, and dorsal aesthetic lines (Modified with permission from Rafael Denadai, MD)

- Nasal bones: narrow or wide (compared to alar base or inter-canthal distance); asymmetry, length, and distance from the midline; high or low radix; prominent or low nasion; and the presence or absence of a dorsal hump or pseudo-hump
- Mid-vault: narrow or wide, upper lateral cartilage collapse, and vertical symmetry
- Nasal tip: asymmetry or fullness; projection (over or under-projected); rotation (over or under-rotated); well or ill-defined tip-defining points; bulbous, boxy, narrow, or parenthesis deformity
- Alar base: position and width (narrow or wide compared to inter-canthal distance)
- Alae: thickness and vertical position; concave or convex ala; alar notching or retraction
- Columella: deviation and length
- Nasal sill: configuration and fullness
- Nostril: size, shape, and symmetry
- Vestibular lining: stenosis or webbing
- Internal and external valves: stenosis; functioning
- Nasal septum: deviation and perforation
- Inferior turbinate: size, shape, and functional status
- Maxillary segment: hypoplasia, retroposition, and asymmetry

A recent guideline provided evidence-based rhinoplasty-focused recommendations (Ishii et al. 2017) which can be transferred to the environment of secondary cleft rhinoplasty:

- The surgeon should ask the patient seeking rhinoplasty about their motivations for surgery and their expectations for the result, should provide feedback on whether those expectations are a realistic goal of the procedure, and should document this discussion in the medical record.
- The surgeon should evaluate the rhinoplasty candidate for nasal airway obstruction during the preoperative evaluation.
- The surgeon should educate rhinoplasty candidates regarding what to expect after surgery, how surgery might affect the ability to breathe through the nose, potential complications of the surgery, and the possible need for future nasal surgery.
- The surgeon should document patients' satisfaction with their nasal appearance and with their nasal function at a minimum of 12 months after rhinoplasty.

Some authors (Byrd et al. 2007a; Lee et al. 2011a, b) have proposed some parameters to support the clinical characterization of the unilateral secondary cleft lip nose deformity:

Key points described by Byrd et al. (2007a):

- Was primary rhinoplasty performed? Was the lateral crus released from the pyriform? Is the nasal lining deficient? Was muscle reconstruction across the nasal sill accomplished? Is the external valve patent and functional? Was malposition of the lateral crus and dome corrected?
- Is tip projection adequate?
- Is the cleft lateral crus deformed by persisting alar crease or buckle?

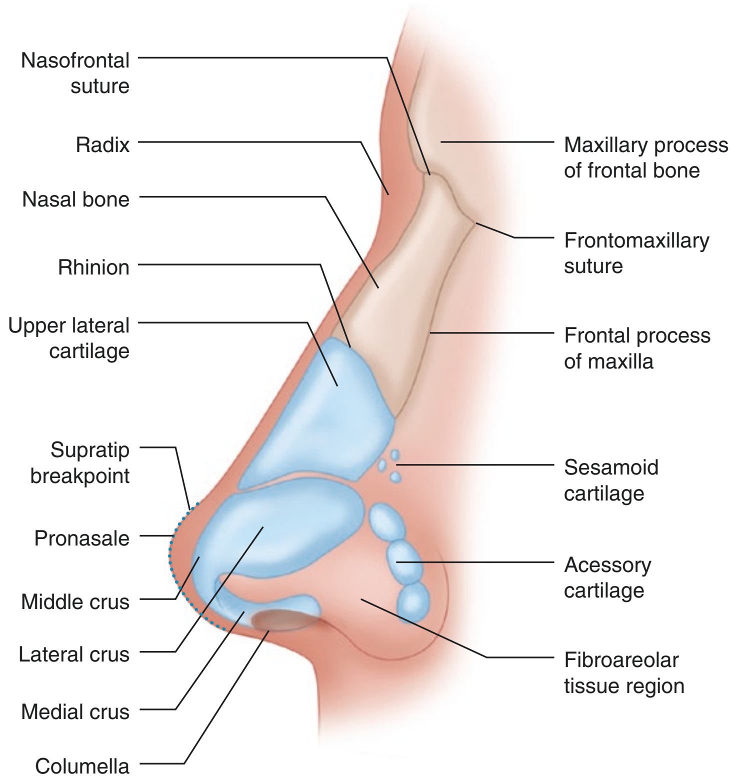

Fig. 22.9 Anatomical details of nasal structures (Modified with permission from Rafael Denadai, MD)

- Is the alar base recessed and tethered to the pyriform?
- Are the pyriform and maxilla hypoplastic?
- Is the projection of the bony dorsum deficient, normal, or over-projecting?

Cardinal deformities of a unilateral secondary cleft lip nose deformity described by Lee et al. (2011a, b):

- Caudal deflection of the nasal septum to the noncleft side
- Deviation of the nasal dorsum to the noncleft side
- Low setting of the medical crus on the cleft side
- Tethering deformity of the lateral crus on the cleft side

Comprehensive and systematic preoperative nasofacial analysis is a key requisite to define surgical goals and achieve patient-specific results. Importantly, aesthetic ideals should be approached cautiously as there is substantial variability among different ethnicities. Therefore, preoperative nasofacial appraisal should be based on accepted cultural standards; different aesthetic nasofacial proportions and bone and soft tissue compositions (e.g., nasal skin and soft tissue envelope thickness) clearly exist in patients of different ethnic descent (Brissett et al. 2020; Kumar and Ishii 2020; Eggerstedt et al. 2020; Denadai et al. 2020c, d; Patel and Most 2020; Su et al. 2020; Dey et al. 2019; Villanueva et al. 2019; Saad et al. 2018; Sakamoto et al. 2014; Rohrich and Bolden 2010; Zhu and Long 2019; Li et al. 2014; Mao et al. 2008; Suhk et al. 2015; Park et al. 2015; Sim et al. 2000; Zhang et al. 2021; An et al. 2021; Na and Jang 2020; Wong et al. 2017; Tiong et al. 2014; Won and Jin 2012; Huang and Liu 2012; Jin and Won 2016, 2011; Kim and Daniel 2012; Jayaratne et al. 2014; Jang and Yi 2014; Jang and Alfanta 2014; Lee and Song 2015; Moon and Han 2018; Jang 2018; Lao et al. 2021). Although great variation exists, there are trends in the nasal anatomical features of a particular ethnic group. Overall, Caucasians typically have a correction or reduction rhinoplasty, whereas Asian nasal surgery is principally for augmentation rhinoplasty. For example, the nasal anatomical features of Asians (i.e., Taiwanese, Chinese, Japanese, Korean, Filipino, Thai, and Vietnamese descent) differ from those of Caucasians (i.e., Fitzpatrick skin type of 1 through 3 and being of European descent); patients of Asian descent typically have a relatively thick nasal skin, a wide nasal base and dorsum, a wide and short bony vault, a widened nasal tip with wide alar bases, and the radix is located more caudally and less prominent compared with the Caucasian patients. The soft tissue envelope is particularly important when trying to modify the nasal tip, and patients with thick skin could require a more aggressive approach to achieve a desired modification in the nasal tip. These ethnic-specific features are important to be recognized during the nasal analysis as well as the selection of proper deformity-specific surgical maneuvers. Understanding the nasal structures' main relationships and consequences of each surgical maneuver on nasal framework and soft tissue response assists in establishing the suitable surgical planning and goals for each particular patient. Moreover, the basal view could be important in understanding the etiology of cleft nasal deformity, but in regular social interactions, nasal form, symmetry, and balance in frontal view are of far greater importance. The frontal view is what the patients appreciate when gazing into a mirror; no matter how good the profile view of the nose looks, if the frontal view is asymmetric, unbalanced, or irregular, the patient could likely be dissatisfied and ask for revisionary surgery. Succeeding a symmetric, balanced, aesthetically pleasing frontal view of the nose is a more complex and challenging task than alignment of the profile view.

Notably, differences in ethnic-based normal values and preferences should also be considered when appraising linear and angular measurements. Adequate projection of nasal tip can be quantified as 50–60% of nasal projection anterior to the upper lip or nasal projection equal to two-thirds of nasal length (Ghavami et al. 2008; Gunter and Hackney 2007; Tanna et al. 2018). The columellar-labial angle also affects nasal tip projection and rotation (Ghavami et al. 2008; Gunter and Hackney 2007; Tanna et al. 2018). The ideal nasolabial angle is approximately 95–100° and 100–110° in men and in women, respectively (Honrado and Pearlman 2003). Ideally, the width-length ratio of the white nose is 0.7 (Powell and Humphreys 1984), whereas in Chinese nose it is observed as 1.1 (Sim et al. 2000). In the book titled *Proportions of the Aesthetic Face*, Powell and Humphreys (1984) mentioned two methods for measuring nasal tip projection: the Baum ratio, which is calculated by dividing the length of the nose (from the nasion to the subnasion) by the length of a perpendicular line from the pronasion to the vertical line joining the pronasion and the subnasion; and the Simons ratio, which is calculated by dividing the length from the subnasion to the pronasion by the length of the subnasion to the superior labium. The ideal tip projection of the white nose has a Baum ratio of 2.8 and a Simons ratio of 1.0 (Powell and Humphreys 1984). The Chinese nasal tip has a mean Baum ratio of 3.0 and Simons ratio of 1.5 (Sim et al. 2000). Multiple parameters present with further differences when a particular ethnical nose is compared with another one.

In addition to concentrating on nasal form, symmetry and balance, the target of a secondary cleft rhinoplasty characteristically involves a functional element as many patients with cleft could present with airway obstruction related to an external nasal deformity, external valve collapse, internal valve collapse, septal deviation, maxillary/vomerine spurs, hypertrophy of the inferior turbinate, or maxillary deformity (Drake et al. 1993; Warren et al. 1990; Warren and Drake 1993; Hairfield and Warren 1989; Zhang et al. 2018; Starbuck et al. 2014; Wang et al. 2017; Scott et al. 2011; Frank-Ito et al. 2019; Ertaş and Ataol 2019; Marcus et al. 2019). Thus, to obtain the realistic treatment goal, that is, a balanced, symmetric facial/nose appearance with proper nasal functioning, both bone and soft-tissue elements should be adequately and timely addressed. A secondary cleft rhinoplasty should not be performed without a proper evaluation and correction of any maxillary deformity requiring skeletal-focused reconstruction. Importantly, chin projection serves as a counterpoint to nasal projection, and retrognathia or micrognathia could lead to the illusion of an over-projected nose (Ghavami et al. 2008; Gunter and Hackney 2007; Tanna et al. 2018). Orthognathic surgery is not advised before the age of 15 years for a female patient and 18 years for a male patient; skeletal maturity is characterized as completing the growth spurt and showing no further increase in height (See Chap. 18).

22.5 Surgical Approach

Secondary cleft rhinoplasty is among the most technically and conceptually challenging procedures subcategories of rhinoplasty for surgeons to achieve consistent reproducible results, requiring a careful, thoughtful, systematic approach to preoperative analysis as well as proper selection of surgical maneuvers to address any particular abnormality. An in-depth understanding of the relationship between the external tip shape and deformities and the underlying structure and its anatomical variations allows the surgeon to properly address the nose in a patient-focused deformity-specific fashion. This understanding of external nasal contour response to the modification of the underlying anatomic structure permits the surgeon to properly set the end point of a symmetric, balanced, and natural-appearing three-dimensional nasal contour as well as to formulate a surgical plan tailored to each patient's need and requirement. The surgeon should anticipate not only the required surgical maneuvers to create a sound nasal structure but also create a robust osteocartilaginous framework that will better tolerate the forces of scar contracture over time.

Overall, secondary cleft rhinoplasty (Fig. 22.6) includes manipulation of the bony pyramid, nasal septum, midnasal vault (Fig. 22.10), nasal tip (Fig. 22.11), inferior turbinate,

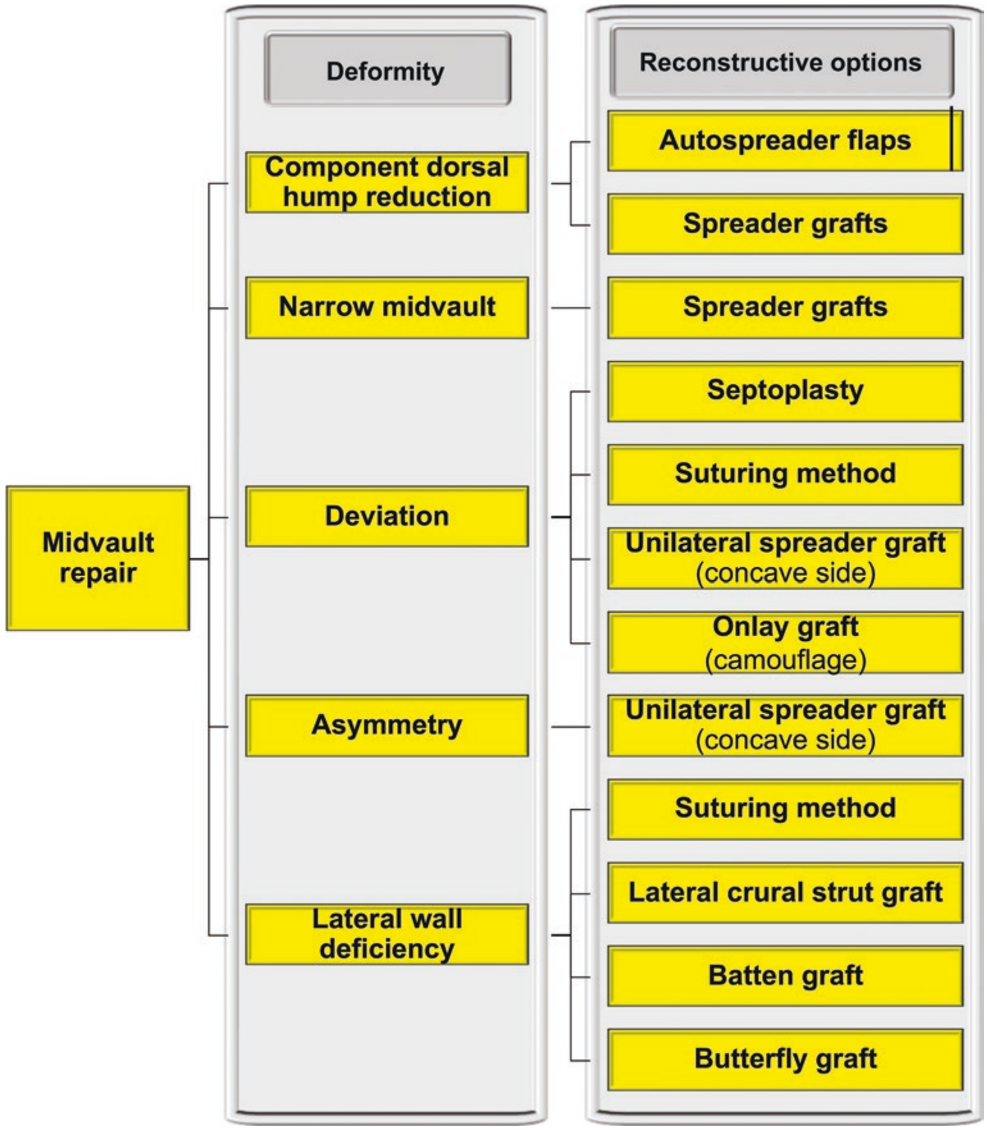

Fig. 22.10 Denadai and Lo's interpretation for surgical tactics for midvault repair in secondary cleft rhinoplasty

nasal airway, and commonly incorporates suturing techniques and cartilage grafts through an open approach. The selection of surgical steps may be debated, and no strict rule is provided as each particular deformity may need a different set of maneuvers to truly achieve the intended result.

Interestingly, surgical techniques regularly adopted in noncleft rhinoplasty could fully be adopted for reconstruction of a secondary cleft lip nose deformity (Sadick et al. 2018; Roostaeian et al. 2014; Geissler et al. 2014; Lee et al. 2011a, 2014; Halewyck et al. 2010; Rohrich et al. 2004, 2002a, 2020, 2017a, 2012a, b; Constantine et al. 2014; Vila et al. 2020; Khoo et al. 2019; Lin et al. 2017; Hsiao et al. 2014; Daniel and Calvert 2004; Cerkes and Basaran 2016; Asadi et al. 2014; Tham et al. 2005; Tan et al. 2016; Erol 2000; Cevizci et al. 2017; Irmak et al. 2018; Calvert and Brenner 2008; Sajjadian et al. 2010; Winkler et al. 2012; Nakakita et al. 1999; Hall et al. 2004; Tebbetts 1998; Robotti 2018; Sawh-Martinez et al. 2019; Cochran and Sieber 2017; Dayan and Rohrich 2020; Gruber et al. 2005a, b, 2008, 2010; Janis et al. 2009; Gunter and Friedman 1997; Rohrich and Afrooz 2018a; Unger et al. 2016; Peck 1983; Sheen 1975; Rohrich and Liu 2010; Nagarkar et al. 2016; Guyuron et al. 2000; Ha and Byrd 2003; Gunter and Rohrich 1992; Ghavami et al. 2008; Rohrich and Griffin 2003; Sieber and Rohrich 2017; Rohrich and Adams 2001; Rohrich and Deuber 2002; Toriumi 2000, 2006, 1995a; Adams et al. 1999; Byrd et al. 1997; Guyuron and Varghai 2003; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Bitik et al. 2015; Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015; Pagan et al. 2021; Jenny et al. 2021; Sharma et al. 2021; Hantawornchaikit et al. 2021; Ren et al. 2021; Hoshal et al. 2020; Zhang et al. 2020, 2021; Chen et al. 2018; Stark et al. 2020; Cohen 2019; Picard et al. 2019; Talaat et al. 2019; Hsieh et al. 2018, 2017; Kehrer et al. 2019; Vass et al. 2016; Cuzalina and Tolomeo 2021; Cuzalina and Jung 2016; Pawar and Wang 2014; Yuan et al. 2018; Rothermel et al.

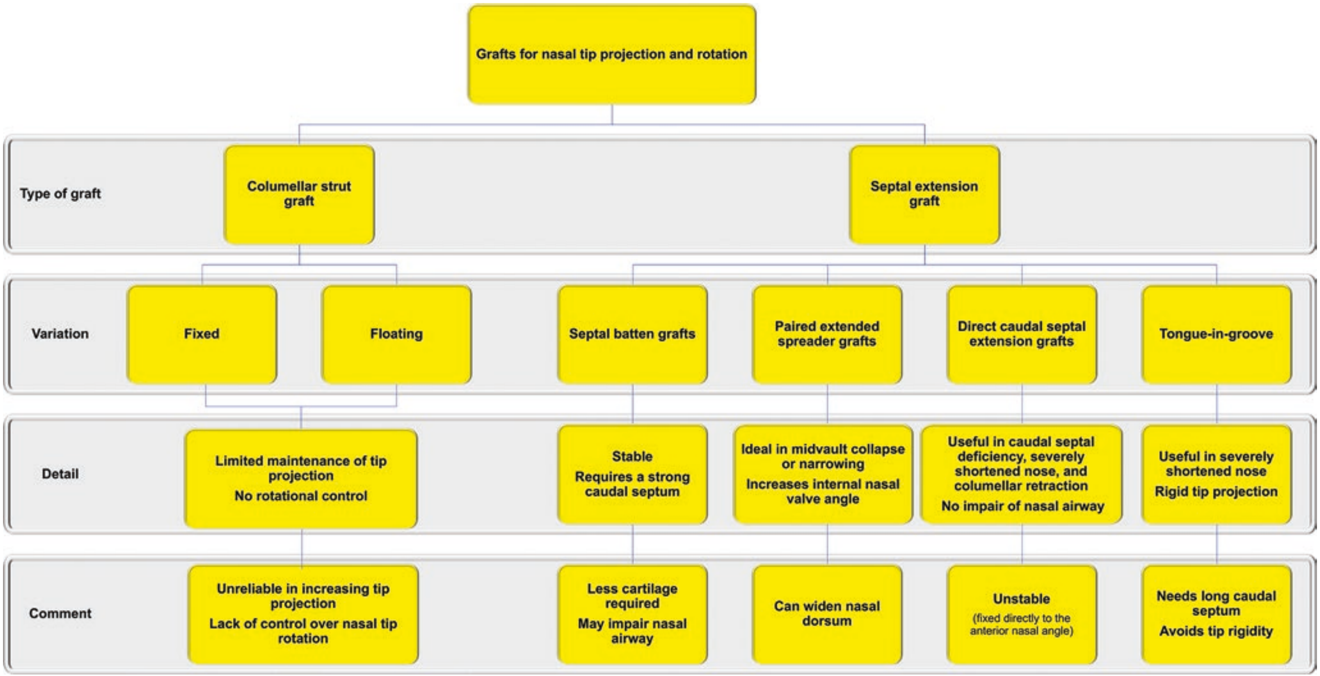

Fig. 22.11 Denadai and Lo's interpretation for grafts for nasal tip projection and rotation in secondary cleft rhinoplasty

2020; van Zijl et al. 2018; An et al. 2021; Na and Jang 2020; Wong et al. 2017; Tiong et al. 2014; Won and Jin 2012; Huang and Liu 2012; Jin and Won 2016, 2011; Kim and Daniel 2012; Jayaratne et al. 2014; Jang and Yi 2014; Jang and Alfanta 2014; Lee and Song 2015; Moon and Han 2018; Jang 2018; Lao et al. 2021).

The successful performance of a secondary cleft rhinoplasty requires a thorough knowledge of procedures used in aesthetic rhinoplasty as well as an in-depth understanding of the cleft lip nose deformity to properly select deformity-specific surgical maneuvers in a patient-specific approach. Overall, mild cleft nasal deformities with minor asymmetries could be corrected with open rhinoplasty-based techniques adopted to reshape the lower lateral cartilage such as middle crura suture, medial crural suture, transdomal suture, interdomal suture, and lateral crural sutures as well as structural cartilage grafts to hold the repaired lower lateral cartilage in its new shape and position. On the other side, severe deformities with major asymmetries could require reconstruction of the entire nasal framework with cartilage grafts from the nasal septum, concha of the ear, or the costal cartilages including: dorsal onlay grafts or radix onlay grafts to increase the nasal dorsum or camouflage any irregularity of the nasal dorsum or radix regions; unilateral or bilateral spreader grafts to straighten the dorsal septum, increase its height and width, and widen the anterior portion of the nasal airway; columellar strut graft or septal extension graft to provide rigidity to the medial and middle crura of the lower lateral cartilages and modify tip projection; unilateral or bilateral lateral crural strut grafts (extended from the columellar strut graft or septal extension graft to the maxillary region, that is, edge of the pyriform aperture region) to shape (straighten and strengthen) the lateral crura of the lower lateral cartilages and support the vestibule airways (opening the nasal airway); unilateral or bilateral alar rim grafts to correct (straighten) any pinching of the nasal tip or inward collapse of the alar margins and to provide a pyramidal format (i.e., equilateral triangle) to the nasal base; invisible (non-projecting) and visible (projecting) nasal tip grafts to support the nasal tip framework as well as enhance projection and shape of the nasal tip. In particular situations with weak, scarred, or destroyed lower lateral cartilage, a new alar cartilage arch can be constructed over and anchored to the existing lower lateral cartilage tissue. Proper designing, carving, and placing of any cartilage graft to compose a strong cartilage framework is considered a key element to achieve a symmetrical, projected, and normal-appearing nasal tip when repairing a secondary cleft nasal deformity. Accurate placement of cartilage grafts supports the nasal tip against scarring process-derived forces that could cause nasal tip relapse during the acute and long-term healing process. These grafts are detailed in the next subheads of this chapter (Okawachi et al. 2020; Liu et al. 2020; Zhou et al. 2020; Park et al. 2020; Oommen et al. 2019; Wolfe et al. 2016; Basta et al. 2014; Hwang et al. 2012; Masuoka et al. 2012; Kaufman et al. 2012; Bashir et al. 2011; Chang et al. 2011; Flores et al. 2009; Sakamoto et al. 2014; Turkaslan et al. 2008; Guyuron 2008; Stal and Hollier 2002; Wei et al. 2017; Han et al. 2017; Nakamura et al. 2016, 2011; Park 2014; Fujimoto et al. 2011; Zbar and Canady 2011; Kim et al. 2008, 2014; Garri et al. 2005; Cho et al. 2002; Foda and Bassyouni 2000; Sàndor and Ylikontiola 2006; Han and Choi 2001; Koh and Eom 1999; Sertel et al. 2017; Sadick et al. 2018; Roostaeian et al. 2014; Geissler et al. 2014; Lee et al. 2011a, 2014; Halewyck et al. 2010; Rohrich et al. 2004, 2002a, 2020, 2017a, 2012a, b; Constantine et al. 2014; Vila et al. 2020; Khoo et al. 2019; Lin et al. 2017; Hsiao et al. 2014; Daniel and Calvert 2004; Cerkes and Basaran 2016; Asadi et al. 2014; Tham et al. 2005; Tan et al. 2016; Erol 2000; Cevizci et al. 2017; Irmak et al. 2018; Calvert and Brenner 2008; Sajjadian et al. 2010; Winkler et al. 2012; Nakakita et al. 1999; Hall et al. 2004; Tebbetts 1998; Robotti 2018; Sawh-Martinez et al. 2019; Cochran and Sieber 2017; Dayan and Rohrich 2020; Gruber et al. 2005a, b, 2008, 2010; Janis et al. 2009; Gunter and Friedman 1997; Rohrich and Afrooz 2018a; Unger et al. 2016; Peck 1983; Sheen 1975; Rohrich and Liu 2010; Nagarkar et al. 2016; Guyuron et al. 2000; Ha and Byrd 2003; Gunter and Rohrich 1992; Ghavami et al. 2008; Rohrich and Griffin 2003; Sieber and Rohrich 2017; Rohrich and Adams 2001; Rohrich and Deuber 2002; Toriumi 2000, 2006, 1995a; Adams et al. 1999; Byrd et al. 1997; Guyuron and Varghai 2003; Hwang and Hwang 2011; Karadavut et al. 2017; Bitik et al. 2015; Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015; Pagan et al. 2021; Jenny et al. 2021; Sharma et al. 2021; Hantawornchaikit et al. 2021; Ren et al. 2021; Hoshal et al. 2020; Zhang et al. 2020, 2021; Chen et al. 2018; Stark et al. 2020; Cohen 2019; Picard et al. 2019; Talaat et al. 2019; Hsieh et al. 2018, 2017; Kehrer et al. 2019; Vass et al. 2016; Cuzalina and Tolomeo 2021; Cuzalina and Jung 2016; Pawar and Wang 2014; Yuan et al. 2018; Rothermel et al. 2020; van Zijl et al. 2018; An et al. 2021; Na and Jang 2020; Wong et al. 2017; Tiong et al. 2014; Won and Jin 2012; Huang and Liu 2012; Jin and Won 2016, 2011; Kim and Daniel 2012; Jayaratne et al. 2014; Jang and Yi 2014; Jang and Alfanta 2014; Lee and Song 2015; Moon and Han 2018; Jang 2018; Lao et al. 2021).

22.5.1 Open Approach

The surgical correction of secondary cleft nasal deformity may be performed through an endonasal (closed) or an open technique. Because of the complexity of secondary cleft nasal deformity, an open technique is preferred for better exposure and visualization of the nasal elements and abnormalities and direct visualization for suturing and manipulating grafts and flaps.

Understanding of the anatomy (blood supply to the nasal tip) as well as adherence to the well-described meticulous surgical principle prevent vascular compromise of the nasal tip skin (Rohrich et al. 1995, 2000; Bafaqeeh and Al-Qattan 2000; Tellioğlu et al. 2005).

The open approach with transcolumellar incision has proven to be a safe and effective technique, even with simultaneous alar base resections or in secondary or tertiary rhinoplasty procedures (Rohrich et al. 1995, 2000; Bafaqeeh and Al-Qattan 2000; Tellioğlu et al. 2005; Unger et al. 2013). The edges of a properly designed and symmetrically positioned transcolumellar incision are easy to line up during final closure. Different designs of transcolumellar incision have been described (Fig. 22.12). The most common position for the transcolumellar incision is between the anterior one third and the posterior two thirds of the columella or at the narrowest part of the columella, with incisions marked at the base of the columella being most frequently adopted for purposes of elongation.

The nose is infiltrated with 1% lidocaine containing 1:200,000 epinephrine. The nasal hair within the vestibule is trimmed if necessary. Dissection of the nasal elements proceeds from inferior to superior. Once the nasal skin flap has been elevated through transcolumellar (V-shaped incision marked along the narrowest portion of the columella), unilateral or bilateral reverse-U (to lengthen the columella and lift the medial footplate as indicated in unilateral and bilateral cleft lip nose deformities), and infracartilaginous (marking 3 mm within the vestibule above the nostril rim) incisions, the lower and upper lateral cartilages are carefully dissected (maintaining the dissection as close to the cartilages as possible) and exposed, avoiding damage to the cartilaginous tissue in the regions of the medial crura (transcolumellar incision area) and domes (soft triangle areas). As the dissection proceeds cranially, the nasal keystone region, that is, the confluence of cartilage (paired upper lateral cartilages caudally and septal quadrangular cartilage anterior-inferiorly) and bone (paired nasal bones cephalically and perpendicular plate of the ethmoid posterior-inferiorly) at the junction of the upper and middle thirds of the nose (Irmak et al. 2020; Simon et al. 2013; Han et al. 2019; Gerbault et al. 2018; Palhazi et al. 2015; Afrooz and Rohrich 2018), is encountered. An elevator can be used to dissect the periosteum off of the nasal bones if a subperiosteal pocket is needed, with subperiosteal dissection restricted to the area of the bony dorsum requiring manipulation. Alternatively, a supraperiosteal pocket can be created across the nasal dorsum as needed.

22.5.2 Nasal Dorsum

Patients could require removal of a dorsal hump or dorsal augmentation.

The dorsal hump is usually not a significant issue for patients with cleft lip nose deformity, but a proper approach should be adopted when dorsal hump reduction is necessary. Component dorsal hump reduction technique (i.e., reducing each component of the nasal dorsum individually) is pre-

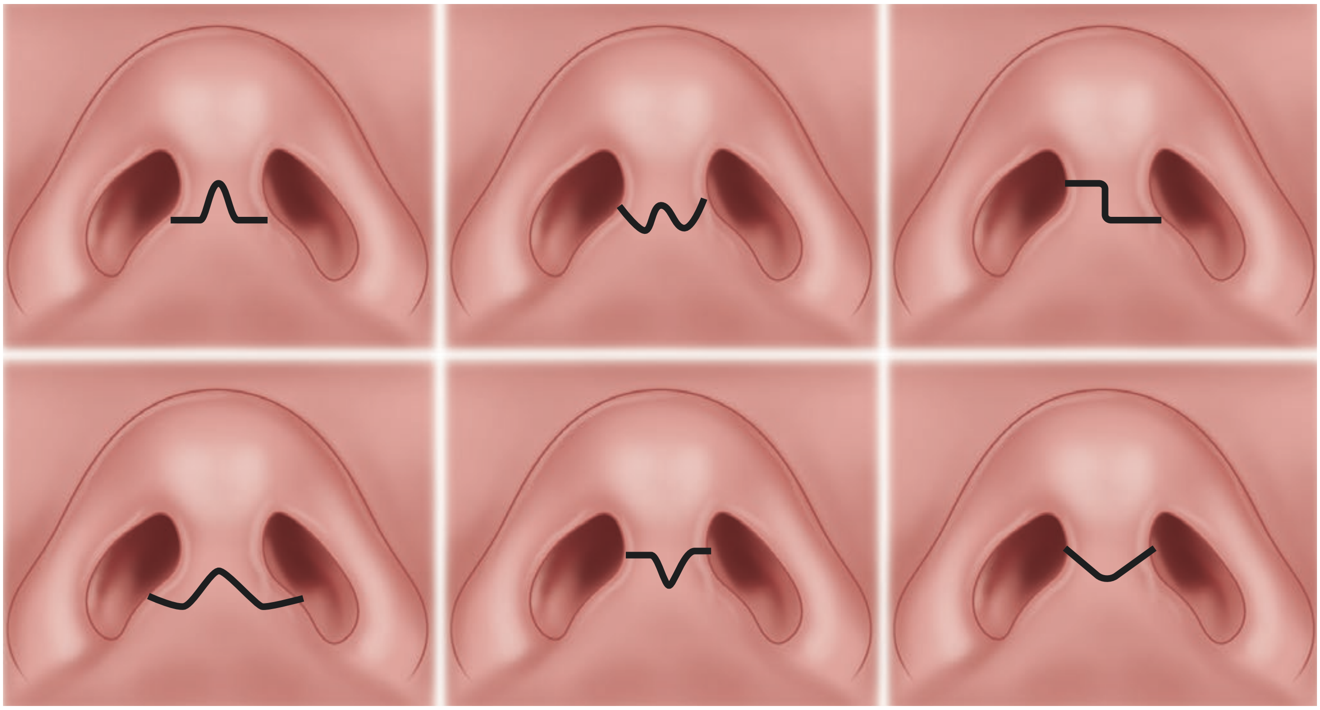

Fig. 22.12 Examples of designs for transcolumellar incision (Modified with permission from Rafael Denadai, MD)

ferred over the composite dorsal reduction (i.e., *en block* reduction; hump is removed in one piece, starting with the sharp incision of the cartilaginous part followed by the removal of the osseous part, preferably with a straight cutting osteotome) (Sadick et al. 2018; Roostaeian et al. 2014; Geissler et al. 2014; Lee et al. 2011b; Halewyck et al. 2010; Rohrich et al. 2004; Hall et al. 2004; Tebbetts 1998; Robotti 2018). Proper understanding of the relationship between the pre-reduction osseocartilaginous nasal vault and the post-reduction nasal vault has been considered more relevant than the surgical method or sequence of maneuvers adopted for dorsal hump reduction: the nasal dorsal hump (an osseocartilaginous structure) originates from the underlying cartilaginous vault and a thin bony cap, with no equal contribution from cartilage and bone elements (i.e., there is no bony hump, only a bony cap that covers a cartilaginous hump) (Zholtikov et al. 2020; Palhazi et al. 2015; Gerbault et al. 2018; Lazovic et al. 2015).

Historically, dorsal reduction achieved by reducing the osseocartilaginous structures in a composite fashion resulted in little control and increased risk for functional and aesthetic complications such as inverted V deformity, internal valve collapse, and irregular dorsal aesthetic lines (called brow-tip aesthetic line). The component dorsal hump reduction maximizes the accuracy and control of resection while allowing selective preservation of any nasal dorsum elements including the septum, upper lateral cartilages, bone, and mucosa. An important aspect of this technique is the separation of upper lateral cartilages from the septum, keeping the vestibular mucosa intact. This approach also allows for a more gradual reduction of each of the osseocartilaginous components. A proper sequence could involve adjusting the cartilaginous vault to the new bony pyramid (or vice-versa) and, finally, reconstructing the dorsum (i.e., final modifications such as smoothening the reduced edges, intranasal or transcutaneous nasal osteotomies, and spreader grafts or flaps if required to avoid an open roof deformity).

A five-step component dorsal hump reduction approach was suggested to avoid the risk of asymmetry and over- or under-reduction while maintaining the upper lateral cartilages (Roostaeian et al. 2014; Geissler et al. 2014; Rohrich et al. 2004):

1. Separation of the upper lateral cartilages from the cartilaginous nasal septum
2. Gradual reduction of the cartilaginous nasal septum
3. Incremental dorsal bony reduction using the rasp (short excursions centrally)
4. Smoothness of the dorsal reduction verified by palpation
5. Final modifications (minimum reduction of the upper lateral cartilage if necessary; spreader flaps or grafts, suturing techniques, osteotomies)

A six-step component dorsal hump reduction approach has also been described (Sadick et al. 2018):

1. Separation of the upper lateral cartilages from the dorsal nasal septum in the subperichondrial plane
2. Separation of the upper lateral cartilages from the junction with the dorsal nasal septum in the subperichondrial plane beneath the nasal bones (i.e., along the cartilaginous and bony vault area)
3. In correlation with the amount of hump reduction required, defined detachment of the upper lateral cartilages from the medial aspect of the nasal bones at the nasal keystone region and their undersurface
4. Reduction of the cartilaginous dorsum
5. Reduction of the bony dorsum while preserving the cranial segment of the upper lateral cartilages in the bony vault area, comparable to an "uncapping" of the upper lateral cartilages with the maintenance of the transverse segment of the upper lateral cartilages at the bony vault defect (uncapped upper lateral cartilages)
6. Realignment of the upper lateral cartilages with the nasal septum using auto-spreader flaps or spreader grafts

In Asian individuals, a common concern is a deficiency in the glabella-radix region (the frontal bone above the radix and between the eyebrows) and its extension into the dorsum (Suhk et al. 2015; Chang and Chang 2020). This glabella-radix region is a key aesthetic component of the face (Suhk et al. 2015; Lee et al. 2018a; Chang and Chang 2020; Park et al. 2018):

- Glabella: the most prominent midpoint of the forehead between the eyebrows
- Radix: the root of the nose (or the lowest point of the nasal dorsum)

The aesthetic contours of the glabella-radix subunit include (Suhk et al. 2015; Lee et al. 2018a; Chang and Chang 2020; Park et al. 2018):

- The brow-tip lines (also known as the dorsal aesthetic lines: a gently diverging curved line between the medial brow and the tip defining points)
- The softly curving forehead-dorsum transition
- The aesthetic nasofrontal angle (ranging from 135° to 140°)

The position of the radix affects the balance of the nasal contour and the length of the nose (Suhk et al. 2015; Lee et al. 2018a; Chang and Chang 2020; Park et al. 2018). Augmenting the radix height extends the dorsal line, bringing it into proportion with the nasal base, and could increase the nasal tip projection (Suhk et al. 2015; Lee et al. 2018a; Chang and Chang 2020; Park et al. 2018). Three favorable outcomes were described for increasing the radix height (Sheen 2000):

1. Minimizing dorsal convexity
2. Preserving skeletal structure
3. Diminishing the apparent projection of the nasal base

Autologous tissue-based nasal dorsum augmentation (i.e., diced costal, auricular or septal cartilage with or without wrapping with rectus muscle fascia, deep temporal fascia, dermis, or cellulose mesh, carved costal cartilage, chimeric costal bone/cartilage graft, parietal bone graft, dermofat, and fat tissue) is preferred over the alloplastic material-based nasal dorsum augmentation procedure (silicone, polytetrafluoroethylene, high-density polyethylene, silicone-polytetrafluoroethylene composite implants, and compound osteocartilaginous graft with polycaprolactone mesh) (Lonic et al. 2021; Daniel 2008; Chang and Chang 2020; Ahn et al. 2020; Kim et al. 2020; Vila et al. 2020; Khoo et al. 2019; Lin et al. 2017; Hsiao et al. 2014; Daniel and Calvert 2004; Cerkes and Basaran 2016; Asadi et al. 2014; Tham et al. 2005; Tan et al. 2016; Erol 2000; Cevizci et al. 2017; Irmak et al. 2018; Calvert and Brenner 2008; Sajjadian et al. 2010; Winkler et al. 2012; Nakakita et al. 1999; Pagan et al. 2021; Jenny et al. 2021; Sharma et al. 2021; Hantawornchaikit et al. 2021; Ren et al. 2021; Hoshal et al. 2020; Zhang et al. 2020; Chen et al. 2018; Stark et al. 2020; Cohen 2019; Picard et al. 2019; Talaat et al. 2019; Hsieh et al. 2018, 2017; Kehrer et al. 2019; Vass et al. 2016; Cuzalina and Tolomeo 2021; Cuzalina and Jung 2016; Pawar and Wang 2014; Yuan et al. 2018; Rothermel et al. 2020; van Zijl et al. 2018). Fat grafting can be adopted to correct minor contour defects or minor nasal dorsum augmentation simultaneously with rhinoplasty (no wide dissection of the nasal dorsum area) or after rhinoplasty. Dermofat graft harvested from sacral area can be adopted to augment the nasal dorsum simultaneously with rhinoplasty. The piece of dermofat graft is inserted into a supraperiosteal pocket (a pocket is created subcutaneously to maintain sufficient blood supply to the graft) using a suture-assisted technique (pullout suture) that is pulled from the inter-eyebrow region. The distal part of dermofat graft can be secured to the lower portion of the upper lateral cartilage to avoid mobilization during the healing process.

22.5.3 Nasal Septum

The nasal septum, a complex osseocartilaginous structure, is composed of a quadrangular cartilage and four bones, including the perpendicular plate of the ethmoid, the vomer, the nasal crest of the maxilla, and the nasal crest of the palatine bone. The septum has an osseocartilaginous interface on three surfaces (Boccieri and Macro 2006; Keefe and Cupp 1999; Gubisch et al. 2020; Heppt and Gubisch 2011; Hur et al. 2016; Prabhu et al. 2009; Kim et al. 2010):

- Cephalically: at the nasal keystone region
- Inferiorly: the anterior nasal spine and maxillary crest
- Posteriorly: along the perpendicular plate of the ethmoid

The septum can be divided into three components:

- Membranous: no cartilage; intrinsic muscles and the depressor septi nasi muscle
- Cartilaginous: septal cartilage sandwiched between the nasal mucosa
- Bone: the connection between the septal cartilage and the perpendicular plate of the ethmoid in an end-to-end pattern; the connection between the septal cartilage and the vomer (stronger connection), maxillary crest, and the palatine crest is formed in a tongue-in-groove pattern

The quadrangular cartilaginous septum is primarily supported on its posterior and inferior margins by the nasal bones, the perpendicular plate of the ethmoid, vomer, and maxillary nasal crest (Rohrich et al. 2017b, 2016; Mowlavi et al. 2006). The anterior border of the septum suspends the skin of the nose and the entire cartilaginous framework. The nasal septum forms a pillar for the nasal dorsum to stand straight in the facial midline while dividing the nasal cavity. The cephalic portion of the septum is rigid and fixed, while the caudal portion is flexible and semifixed. Mucoperichondrium is tightly attached to the septal cartilage from the caudal border to the 10–15 mm cephalic portion of the vestibular mucosa, and it becomes looser toward the inner septal mucosa (Boccieri and Macro 2006; Keefe and Cupp 1999; Gubisch et al. 2020; Heppt and Gubisch 2011). The anterior septal angle represents the anteriormost projecting point of the septum, and contributes to nasal tip support, tip projection, nasal length, airway function, and internal nasal valve function. The fibrous suspensory ligament of the nasal tip spans the septal angle, suspending the lower lateral cartilages. The position of the upper lateral cartilages is indirectly affected by septal angle position through fibrous attachments to the cephalic margin of the lower lateral cartilages (Rohrich et al. 2017b, 2016; Mowlavi et al. 2006).

Septoplasty may be required in patients who present with signs of nasal obstruction and/or deviation or in patients without signs of septal deformity, as a preferred donor site for cartilage grafts (Boccieri and Macro 2006; Keefe and Cupp 1999; Gubisch et al. 2020; Heppt and Gubisch 2011). The nasal septum can be approached (i.e., subperichondrial dissection with blue/gray appearance of the cartilage) by splitting the lower lateral cartilages between the medial crura (called an open dorsal approach), providing a full-direct view of the septum. This is achieved by dividing the suspensory ligament between the medial crura and identification of the anterior septal angle (i.e., the portion of the nasal septum where the anterior nasal septum meets the caudal nasal septum); the prominence of the anterior septal angle could usually be palpated. The portions of the anterior septal angle can be injected to facilitate dissection with no disruption of the mucoperichondrium. After scoring the perichondrium 2–3 mm posterior to the anterior septal angle, a submucoperichondrial tunnel deep to the upper lateral cartilages is developed with a freer or Cottle elevator. Submucoperichondrial dissection proceeds initially in a posterior direction, and then inferiorly and anteriorly. As submucoperichondrial dissection proceeds toward the junction of the septum and upper lateral cartilages, the elevator is rolled gently under the upper lateral cartilage in an effort to dissect mucoperichondrium from the overlying upper lateral cartilages for several millimeters, ensuring that the nasal lining is not disrupted with the forthcoming separation of the upper lateral cartilages from the dorsal septum. After bilateral submucoperichondrial dissection, the upper lateral cartilages can be separated from the dorsal septum (preserving maximal horizontal length of the upper lateral cartilages) at the upper lateral cartilage–septal junction as needed. The upper lateral cartilage–septal junction is separated up to the level of the nasal bones. The upper lateral cartilages are gently retracted, and the dorsal septum is trimmed incrementally to the desired height (component dorsal hump reduction). The bony dorsum is then rasped incrementally to the desired level, avoiding disruption of the cartilaginous septum from the perpendicular plate of the ethmoid at the level of the keystone region.

A central portion of the septum can be harvested (Figs. 22.13 and 22.14) to obtain cartilage for deformity-specific cartilage grafting as well as to correct septal deviation causing nasal airway obstruction. A strong and straight L-shaped frame (at least 15 mm dorsally and 10 mm caudally; L-strut) should be left to support the nose, avoiding nasal collapse over time. Importantly, the septal cartilage beneath the keystone region should be maximally preserved to maintain the stability of septal support (Mau et al. 2007; Han et al. 2019; Hur et al. 2016). The remaining septal L-strut is reassessed for deviation; the persistent caudal septal deviation is usually caused by vertical excess of the anterior septum (Constantine et al. 2014).

The deviated anterocaudal septum can be released from its ligamentous attachments to the anterior nasal spine and maxillary crest regions. The mucoperichondrium should be elevated completely off the caudal end of the septum down to the anterior nasal spine. Any vertical excess is excised. The caudal septum is then re-secured to the contralateral aspect of the anterior nasal spine region. The deviated portion can also be abraded on the concave side, and then fixed in the medialized position

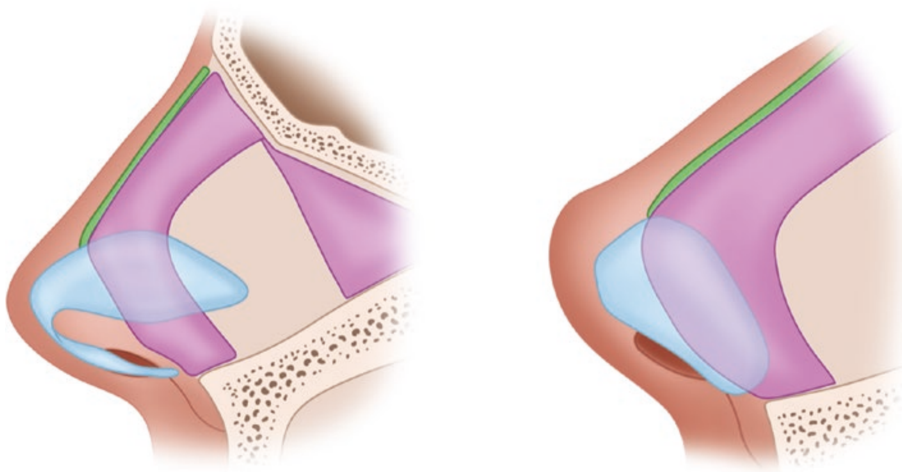

Fig. 22.13 (Left) The septum is composed of the quadrangular cartilage (purple), the perpendicular plate of the ethmoid, and the vomer. The keystone area is the major support mechanism of the L-strut. After a cartilage graft harvesting, the caudal strut should be wider than 10–15 mm (dorsal and caudal septal cartilage preservation). The keystone area should be maintained for dorsal and tip support. (Right) Example of septal extension graft (Modified with permission from Rafael Denadai, MD)

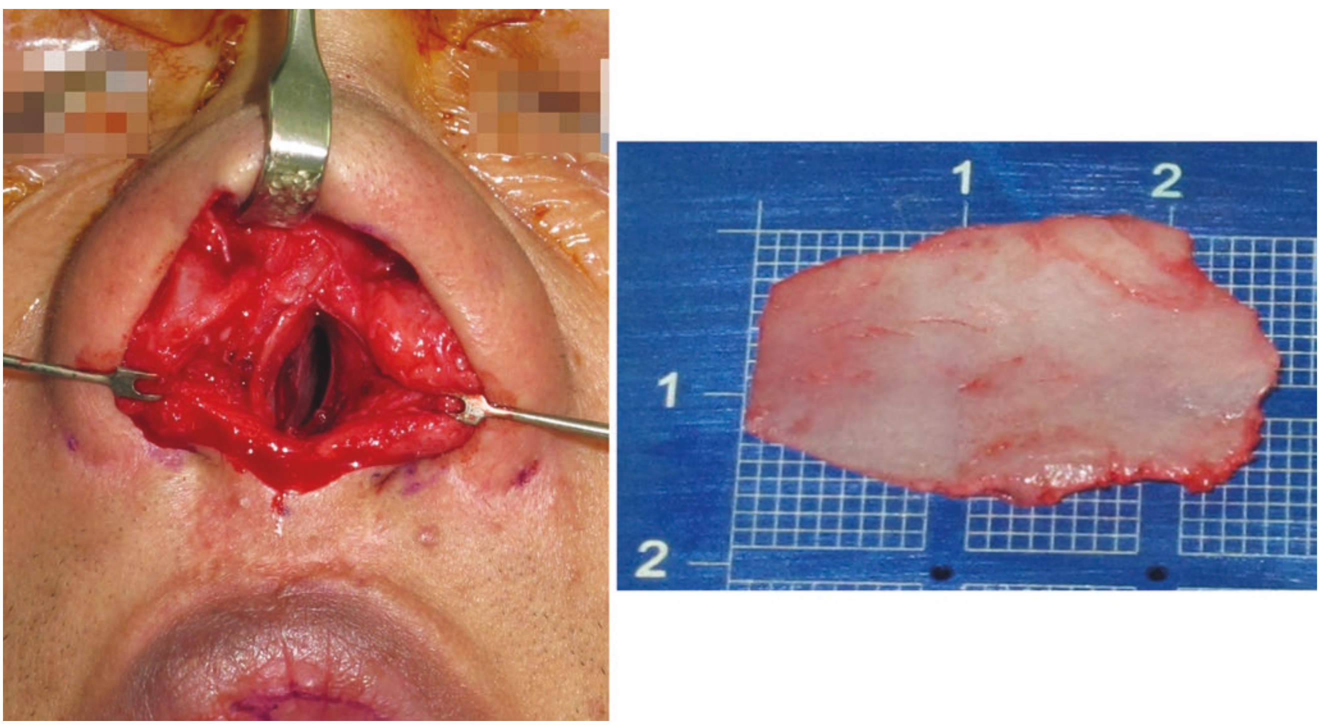

Fig. 22.14 Nasal septum is one of the best cartilaginous donor sites for autologous nasal grafting in secondary cleft rhinoplasty

through the premaxillary periosteum. Scoring or partial-thickness wedge excisions along with batten support grafts have also been described to create a straight and stable L-strut (Rohrich et al. 2002b; Gunter and Rohrich 1988). It is imperative to reflect that some of these septal maneuvers, that is, open approach, anterior nasal spine manipulation, and shortening of the anterocaudal septum could truly impact nasal tip projection and rotation. A columellar strut graft or a septal extension graft can be utilized to support and unify the tip complex as well as if changes in tip projection or rotation are required.

The septoplasty could also include resection with a rongeur of the most posterior portion of the septal quadrilateral cartilage, deviated vomer bone, bone spurs, and deviated portions of the perpendicular plate of the ethmoid bone (careful resection to avoid transmission of forces cephalad that can injure the cribriform plate) when deviated to help achieve a patent nasal airway (Boccieri and Macro 2006; Keefe and Cupp 1999; Gubisch et al. 2020; Heppt and Gubisch 2011).

22.5.4 Middle Nasal Vault

The middle third of the nose is composed of the upper lateral cartilages and the lower third of nasal bones, with a unique transition between these structures and the underlying septal cartilage and ethmoid bone structures. Patients could present with deviated nose, narrow midvault, asymmetry, or collapsed internal valve, requiring proper repair. During midvault-focused surgery, a meticulous effort is made to ensure a smooth transition from the bony dorsum to the cartilaginous dorsum, avoiding an inverted-V deformity while optimizing long-term stability (Afrooz and Rohrich 2018; Roostaeian et al. 2014; Sheen 1984; Byrd et al. 2007b; Rohrich et al. 2016). Rhinoplasty terminology definitions have been described (Avashia et al. 2020):

- Large dorsal hump reduction (component dorsal hump reduction >2 mm)
- Small dorsal hump reduction (component dorsal hump reduction <2 mm)
- Dynamic valve collapse (nasal valve obstruction secondary to internal valve collapse during inspiratory effort)
- Static valve collapse (nasal valve obstruction secondary to narrow interval valve angle resulting in obstruction unrelated to breathing cycle)
- Angulated dorsal septum (angulated appearance of the nasal dorsum on frontal view when compared with a line drawn from radix to nasal tip)
- Straight dorsal septum (nasal dorsum is parallel on frontal view when compared with a line drawn from radix to nasal tip)

The lateral wall of the nose has been divided into zones 1 and 2: zone 1 represents the upper lateral cartilage along the sidewall of the middle nasal vault; and zone 2 represents the lower or more caudal on the sidewall near the supraalar groove (Most 2008; Toriumi 2020). Asymmetry of the upper lateral cartilage may be the source of nasal deviation. The upper lateral cartilage consists of vertical and horizontal components and a classification system has been proposed (Hafezi et al. 2020):

- Class I: vertical and horizontal upper lateral cartilage subunits are equal on both sides
- Class II: the horizontal subunit is wider on one side; the vertical segment has a normal size and curvature
- Class III: horizontal components are equal and normal in shape, but the vertical segment is more convexity on one side
- Class IV: the horizontal segment is wider and the vertical segment is more convex on one side
- Class V: the horizontal segment is narrower and the vertical segment is concave on one side

Unilateral or bilateral auto-spreader flaps (if excess upper lateral cartilage is available) or spreader grafts may be used (Afrooz and Rohrich 2018; Roostaeian et al. 2014; Sheen 1984; Byrd et al. 2007b, 1998; Rohrich and Hollier 1996; Constantian and Clardy 1996; Seyhan 1997; Oneal and Berkowitz 1998; Fomon et al. 1950; Apaydin 2016a, b, 2013a, b; Sazgar 2016; Cerkes 2011, 2013; Toriumi 1995b; Ishida et al. 1999; Lohuis et al. 2012; Ashrafi 2014; Gruber et al. 2007a; Saedi et al. 2014; Gwanmesia et al. 2015; Kovacevic et al. 2016; André and Vuyk 2006; Avashia et al. 2020; Rohrich et al. 2016) for different purposes:

- Reconstitute or maintain the anatomy of the middle vault with a smooth transition and equalization of width between the bony and cartilaginous dorsum
- Create a smooth transition at the keystone region
- Prevent midvault collapse
- Restore or maintain the patency of the internal nasal valves (spacer and widen the angle)
- Recreate or maintain the brow-tip aesthetic lines (laterally and dorsally)
- Compensate a deviated dorsal segment of the nasal septum (unilateral graft or flap when the dorsal segment is concave or depressed on one side)

Carved cartilaginous spreader grafts (septum or rib) have been sutured to the dorsal segment of the cartilaginous septum, that is, grafts are positioned parallel between the superior edge of the nasal septum and the medial edges of the upper lateral cartilages. Different types of spreader grafts have been described (Apaydin 2016a, b, 2013a, b; Sazgar 2016; Byrd et al. 1998; Cerkes 2011; Sheen 1984; Toriumi 1995b; André and Vuyk 2006):

- Rectangular (Sheen 1984; Toriumi 1995b; Rohrich et al. 2016)
- Beveled (Toriumi 1995a, b)
- One sided (Byrd et al. 1998; Cerkes 2011)
- Asymmetric (thickness) (Cerkes 2011)
- Two-layered (Apaydin 2016a)
- Splinting (Apaydin 2013a, b, 2016a, b; Sazgar 2016)
- Reconstructive (Apaydin 2013a; Toriumi 2013)
- L-strut (Apaydin 2013a, b; André and Vuyk 2006)

Different types of auto-spreader flaps have also been described (Ishida et al. 1999; Ashrafi 2014; Lohuis et al. 2012; Wurm and Kovacevic 2013; Gruber et al. 2007a; Byrd et al. 2007b; Saedi et al. 2014; Cerkes 2013; Apaydin 2016a; Gwanmesia et al. 2015; Kovacevic et al. 2016; André and Vuyk 2006; Oneal and Berkowitz 1998; Seyhan 1997; Rohrich et al. 2016):

- Suturing of the upper lateral cartilages to the nasal septum after septal hump reduction (Ishida et al. 1999; Ashrafi 2014; Lohuis et al. 2012)
- Suturing of the upper lateral cartilages over the nasal septum after septal hump reduction (Ashrafi 2014)
- Turn-in flap using four methods (no incision; partial incision cephalically; reshaping partial incisions; or total incision) (Oneal and Berkowitz 1998; Seyhan 1997; André and Vuyk 2006; Gruber et al. 2007a; Byrd et al. 2007b; Saedi et al. 2014; Cerkes 2013; Apaydin 2016a)
- Suturing of the upper lateral cartilages to the nasal septum and over the spreader grafts (Gwanmesia et al. 2015; Kovacevic et al. 2016)
- Suturing of the upper lateral cartilages over the nasal septum and the spreader grafts (Ashrafi 2014; Apaydin 2016a)
- Turn-in flaps sutured to the spreader grafts (Apaydin 2016a)

The adoption of spreader grafts and auto-spreader flaps are among the most commonly employed surgical maneuvers employed to address the midvault during rhinoplasty, but other methods have also been used for selected cases (Fedok 2016; Stacey et al. 2009; Becker and Becker 2003; Toriumi et al. 1997; Jalali 2015; Guyuron and Behmand 2003a; Park 1998; Rohrich et al. 2016):

- Butterfly grafts (Stacey et al. 2009)
- Alar batten grafts (Becker and Becker 2003; Toriumi et al. 1997)
- Suturing maneuvers (flaring suture or septal rotation suture) (Jalali 2015; Guyuron and Behmand 2003a; Park 1998)

Horizontal mattress sutures can also be placed as necessary to reconstitute the symmetry of the cartilaginous midvault, including a septal rotation suture, that is, the horizontal mattress suture is placed more cephalically on the side where the intended rotation is desired and more caudally on the opposite side; as the suture is tightened, the septum shifts in the intended direction (Guyuron and Behmand 2003a).

22.5.5 Nasal Tip

In a cleft nasal deformity, the nasal tip is often underprojected and ill-defined, requiring proper correction.

Conceptually, the nasal tip complex is described as a nasal tripod, and surgical-induced modifications to any of the limbs could lead to changes in rotation and/or projection of the nasal tip. The nose should be natural in appearance with good symmetry and appropriate length and rotation. The ideal nasal base should fit within an equilateral triangle, and the alar rims should be relatively straight; weak or excessively thick alae could result in a concave or convex shape, respectively, and fall outside this intended triangle.

Successful control of projection and rotation of the nasal tip is a key component of the current rhinoplasty approach. Overall, the shape, projection, and rotation of the nasal tip region are principally determined by the lower lateral cartilages plus its fibrous attachments, with the further influence of adjacent structures such as the upper lateral cartilages, nasal septum, nasal base, and piriform aperture (Lee et al. 2014; Janeke and Wright 1971; Soliemanzadeh and Kridel 2005; Papel and Mabrie 1999; Toriumi 2006; Adams et al. 1999). Tip projection is a product of several anatomical factors including length and strength of the lower lateral cartilages, the suspensory ligament, fibrous connections of the lower lateral cartilages to the upper lateral cartilages, and the anterior septal angle.

Major tip support structures consist of the following (Lee et al. 2014; Janeke and Wright 1971; Soliemanzadeh and Kridel 2005; Papel and Mabrie 1999; Toriumi 2006; Adams et al. 1999):

- Fibrous connection of lateral crura to the upper lateral cartilage
- Abutment and attachment of the lateral crural complex to the pyriform aperture
- Fibrous attachment of the medial crura footplate to the caudal septum and maxillary spine
- Suspensory interdomal tip ligament

Minor tip support structures consist of the following (Lee et al. 2014; Janeke and Wright 1971; Soliemanzadeh and Kridel 2005; Papel and Mabrie 1999; Toriumi 2006; Adams et al. 1999):

- Fibrous attachments of alar cartilage to cartilaginous dorsum
- Alar cartilage attachment to skin
- Membranous septum

Creating a natural-appearing nasal tip contour is a complex task, requiring a three-dimensional approach. Many surgical methods and composition of maneuvers have been described to correct nasal tip deformities, improve nasal tip shape, and minimize loss of support, including (Sawh-Martinez et al. 2019; Cochran and Sieber 2017; Dayan and Rohrich 2020; Rohrich et al. 2002a, 2020, 2017a, 2012a, b; Gruber et al. 2005a, b, 2008, 2010; Janis et al. 2009; Gunter and Friedman 1997; Rohrich and Afrooz 2018a; Unger et al. 2016; Peck 1983; Sheen 1975; Rohrich and Liu 2010; Nagarkar et al. 2016; Guyuron et al. 2000; Ha and Byrd 2003; Gunter and Rohrich 1992; Lee et al. 2014; Ghavami et al. 2008; Rohrich and Griffin 2003; Sieber and Rohrich

2017; Rohrich and Adams 2001; Rohrich and Deuber 2002; Toriumi 2000, 2006, 1995a; Adams et al. 1999; Byrd et al. 1997; Guyuron and Varghai 2003; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Bitik et al. 2015; Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015):

- Cephalic trim
- Nasal tip suturing methods
- Grafting methods

Many visible and invisible grafting techniques have commonly been used to shape and support the tip complex (Sawh-Martinez et al. 2019; Cochran and Sieber 2017; Dayan and Rohrich 2020; Rohrich et al. 2002a, 2020, 2017a, 2012a, b; Gruber et al. 2005a, b; Janis et al. 2009; Gunter and Friedman 1997; Rohrich and Afrooz 2018a; Unger et al. 2016; Peck 1983; Sheen 1975; Rohrich and Liu 2010; Nagarkar et al. 2016; Guyuron et al. 2000; Ha and Byrd 2003; Gunter and Rohrich 1992; Lee et al. 2014; Ghavami et al. 2008; Rohrich and Griffin 2003; Sieber and Rohrich 2017; Rohrich and Adams 2001; Rohrich and Deuber 2002; Toriumi 2000, 2006, 1995a; Adams et al. 1999; Byrd et al. 1997; Guyuron and Varghai 2003; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Bitik et al. 2015), including:

- Columellar strut graft
- Septal extension graft
- Nasal tip graft

These surgical methods are powerful techniques to correct nasal tip deformities and refine the nasal tip which should be employed judiciously and in a graduated manner after careful preoperative and intraoperative assessment. All components of the tip complex should sensibly be appraised to ensure that the appropriate shaping maneuvers are employed to correct the secondary cleft nasal deformity, providing a corrected tip position while maintaining adequate structural support.

Importantly, prior to modifying or refining the contour of the nasal tip lobule (region of the domes), deficiencies of the base of the nose should be properly corrected, ensuring not only a solid foundation for the lower third of the nose but also setting the position of the nasolabial angle and alar-columellar relationship as well as avoiding loss of the nasal tip projection postoperatively. Nasal tip support relies on the structure of the crura (length and strength), intercrural ligament integrity, nasal tip soft-tissue thickness, adopted domal suture technique, adopted nasal tip grafts, and, possibly most strongly, cartilage grafts (Figs. 22.14, 22.15, 22.16, 22.17, 22.18, 22.19, 22.20, 22.21, 22.22, 22.23, 22.24, 22.25, and 22.26) to achieve support between the medial crura. Adjustments of the nasal septum is now considered the predominant factor in augmenting tip projection and rotation. Overall, patients with the long medial crura and medial crural footplates that extend down to the anterior nasal spine region are less likely to lose nasal tip projection during postoperative follow-up compared with patients with short medial crura and footplates that do not reach the posterior septal angle (anterior nasal spine region). Which technique is used depends on each patient's specific anatomic deficiencies and surgical goals, including the necessity to alter nasal tip projection, the alar-columellar relationship, and the nasolabial angle as well as to stabilize the base of the nose. There are different reliable and versatile surgical methods, that is, suturing the medial crura to a columellar strut graft (Rohrich et al. 2020, 2012a, b; Bitik et al. 2015) or a septal extension graft (Rohrich et al. 2020; Chen et al. 2020; Byrd et al. 1997; Guyuron and Varghai 2003; Ha and Byrd 2003; Toriumi 2006, 1995a, b; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Ponsky et al. 2010; An et al. 2019; Gürsoy et al. 2019; Lee et al. 2018b; Hwang and Dhong 2018), that can achieve these goals. These are the two most common grafts to establish the lower limb of the tripod for nasal tip support and serve as an anchor for the repositioned nasal tip. Both approaches could allow for control of nasal tip support, nasal tip projection, and shape of the medial crura, but differences in indication and magnitude and predictability of change have been described (Rohrich et al. 2020, 2012a, b; Bitik et al. 2015; Byrd et al. 1997; Guyuron and Varghai 2003; Ha and Byrd 2003; Toriumi 2006, 1995a, b; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Ponsky et al. 2010).

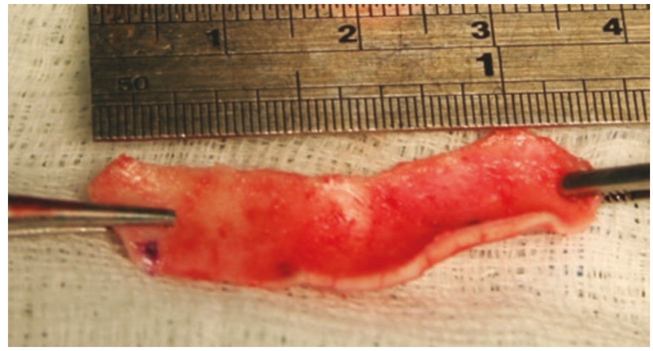

Fig. 22.15 Auricular concha is a further cartilaginous donor site for autologous nasal grafting in secondary cleft rhinoplasty

The columellar strut graft placed in a pocket dissected between the medial crura has been used to unify the tip complex, maintain/modify tip projection, treat medial crural deformities, or treat columellar deformities. This graft can be floating (the most common approach) into a soft-tissue pocket between the medial crura or stabilized on the anterior nasal spine region (Rohrich et al. 2020, 2012a, b; Bitik et al. 2015). Essentially, the soft tissue pocket should not extend to

Fig. 22.16 Patient with unilateral cleft nasal deformity treated with secondary rhinoplasty (Tajima method, ARCH cartilage graft, and tip cartilage graft)

Fig. 22.17 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (auricular concha graft for nasal tip rotation and projection and nostrils narrowing)

the anterior nasal spine region; maintaining a pad of soft tissue between the posterior end of the columellar strut graft and the anterior nasal spine region prevents the strut from directly contacting the bone area, avoiding the "clicking" sensation. A warped columellar strut graft can be straightened by mattress sutures placed against the curve.

Different forms of columellar strut grafts have been described (Rohrich et al. 2020, 2012a, b; Bitik et al. 2015). It is the degree of nasal tip projection and structural integrity of the lower lateral cartilages that dictates how the columellar strut graft should be placed. For example, a patient with an adequate nasal tip projection in the presence of weak or asymmetric lower lateral cartilages warrants placement of a shorter columellar strut graft to strengthen and unify tip elements, rather than a longer floating strut more suitable for patients who present with nasal tips that also lack tip projec-

Fig. 22.18 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (auricular concha graft for nasal tip rotation and projection and nostrils narrowing)

Fig. 22.19 Patient with unilateral cleft nasal deformity treated with secondary rhinoplasty (Tajima method, ARCH cartilage graft, and tip cartilage graft)

tion (Rohrich et al. 2020). A study specifically evaluating the effect of floating columellar struts in increasing tip projection demonstrated that such effect, if any, was minimal (Rohrich et al. 2012b). It has been recommended that columellar strut graft should be seen as an effective graft for unifying the nasal tip and maintaining its position in the presence of three distinct structural characteristics (Rohrich et al. 2020):

- Weak medial or middle crura
- Asymmetric lower lateral cartilages
- Short medial crura

Columellar strut graft is a useful tool in properly selected patients, but it has been associated with some drawbacks (depending on the form of columellar strut graft used) such as widening the columella, clicking against the anterior nasal

Fig. 22.20 Patient with unilateral cleft nasal deformity treated with secondary rhinoplasty (Tajima method, ARCH cartilage graft, and tip cartilage graft)

spine region, and warping (as with all cartilage grafts) with the loss of nasal tip projection and symmetry (Rohrich et al. 2020, 2012a, b; Bitik et al. 2015). Moreover, columellar strut grafts have been considered an unreliable tool in increasing tip projection, but it is the lack of control over nasal tip rotation that has been considered the single most important limitation of this particular graft (Rohrich et al. 2020, 2012a, b; Bitik et al. 2015).

Septal extension grafts (Fig. 22.13, 22.23, 22.24, 22.25, and 22.26) were introduced as a more reliable method of controlling nasal tip projection, shape, and rotation, particularly in patients with weak lower lateral cartilages (Byrd et al. 1997). Septal extension grafts were also proposed as a way of redefining the relationship between the nasal tip and dorsum. Creating structural support for the nasal tip complex based on the anterior septum allows for predictable control of tip projection and/or rotation. The septal extension graft allows for greater versatility in nasal tip rotation as well as nasal tip projection and support (Rohrich et al. 2020; Byrd et al. 1997; Guyuron and Varghai 2003; Ha and Byrd 2003; Toriumi 2006, 1995a, b; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Ponsky et al. 2010).

The septal extension graft is fixed (overlapping or end-to-end) to the caudal septum as a stable graft on which to affix the new domal elements and medial crura. To be fully effective, septal extension grafts should extend beyond the anterior septal angle into the interdomal space. The most caudal and inferior portion of the septal extension graft is placed on the cephalic border of the medial crus at the columellar-lobular angle. The most important point of fixation is inferior to the divergence of the middle crura, where the cephalic borders of the medial crura share their boundaries. At this point, the septal extension graft incorporates the desired columellar-lobular angle (Rohrich et al. 2020; Byrd et al. 1997; Guyuron and Varghai 2003; Ha and Byrd 2003; Toriumi 2006, 1995a, b; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Ponsky et al. 2010).

Fig. 22.21 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (rib graft for nasal tip rotation and projection and nostrils narrowing)

There are numerous types of septal extension grafts with different shapes and points of fixation to the caudal septum region, including paired extended spreader grafts, septal batten grafts (paired or unilateral) extending across the caudal and dorsal septum, direct caudal septal extension grafts, and tongue-in-groove technique (Rohrich et al. 2020; Byrd et al. 1997; Guyuron and Varghai 2003; Ha and Byrd 2003; Toriumi 2006; Hwang and Hwang 2011; Kim et al. 2014; Karadavut et al. 2017; Ponsky et al. 2010).

The adoption of septal extension grafts demands special attention to selecting the appropriately shaped graft, careful judgment for placement, and setting the nasal tip position and alar-columellar relationship, and stable fixation. The cephalic portion of the graft is overlapping the existing caudal septum, with the caudal margin of the extension graft in the midline. The cephalic portion of the graft that overlaps the caudal septum can be trimmed or beveled so that it does not obstruct the nasal airway. Alternatively, the use of the septal extension graft for controlling tip projection by placing it end to end has also been described; the adoption of extended spreader grafts to support the septal extension graft has also been proposed (Byrd et al. 1997; Guyuron and Varghai 2003). The caudal margin of the septal extension graft must be vertical and midline to correct a deviated nasal tip or avoid the nasal tip deviation postoperatively. For example, if the anterocaudal septum is slightly deviated to the patient's left, the septal extension graft could be overlapped on the right side. The shape and positional orientation of the septal extension graft can also be changed to offer distinctive effects on the nasal tip position. For the ptotic nasal tip with an acute nasolabial angle, a long septal extension graft (longer along its inferior margin) results in upward nasal tip rotation (enhance the deficient nasolabial angle) while stabilizing the base of the nose. If nasal lengthening is needed, a long septal extension graft (longer along its superior margin) results in counter-rotation of the nasal tip, that is, the longer superior margin of the septal extension graft pushes the nasal tip down to lengthen the nose.

A recent three-dimensional imaging-based outcome study compared columellar strut graft versus septal extension graft for changes in tip projection, tip rotation, and nasal length at early and late postoperative time points (6 weeks and >12 months postoperatively, respectively) (Sawh-Martinez et al. 2019). Overall, the authors' concluded that nasal tip projection and rotation appear to decrease from the immediate postoperative position; both septal extension graft and columellar strut graft procedures exhibit similar changes in tip projection with time, but septal extension graft is better able to preserve tip rotation compared with the columellar strut graft-based approach (Sawh-Martinez et al. 2019).

In this outcome study (Sawh-Martinez et al. 2019), nasal tip projection and nasal length decreased from early to late postoperative time in both the columellar strut group and the caudal septal extension group, but with no significant difference between groups. It was observed a significant difference in tip rotation for the columellar strut group compared with the caudal septal extension graft group (−5.08% versus

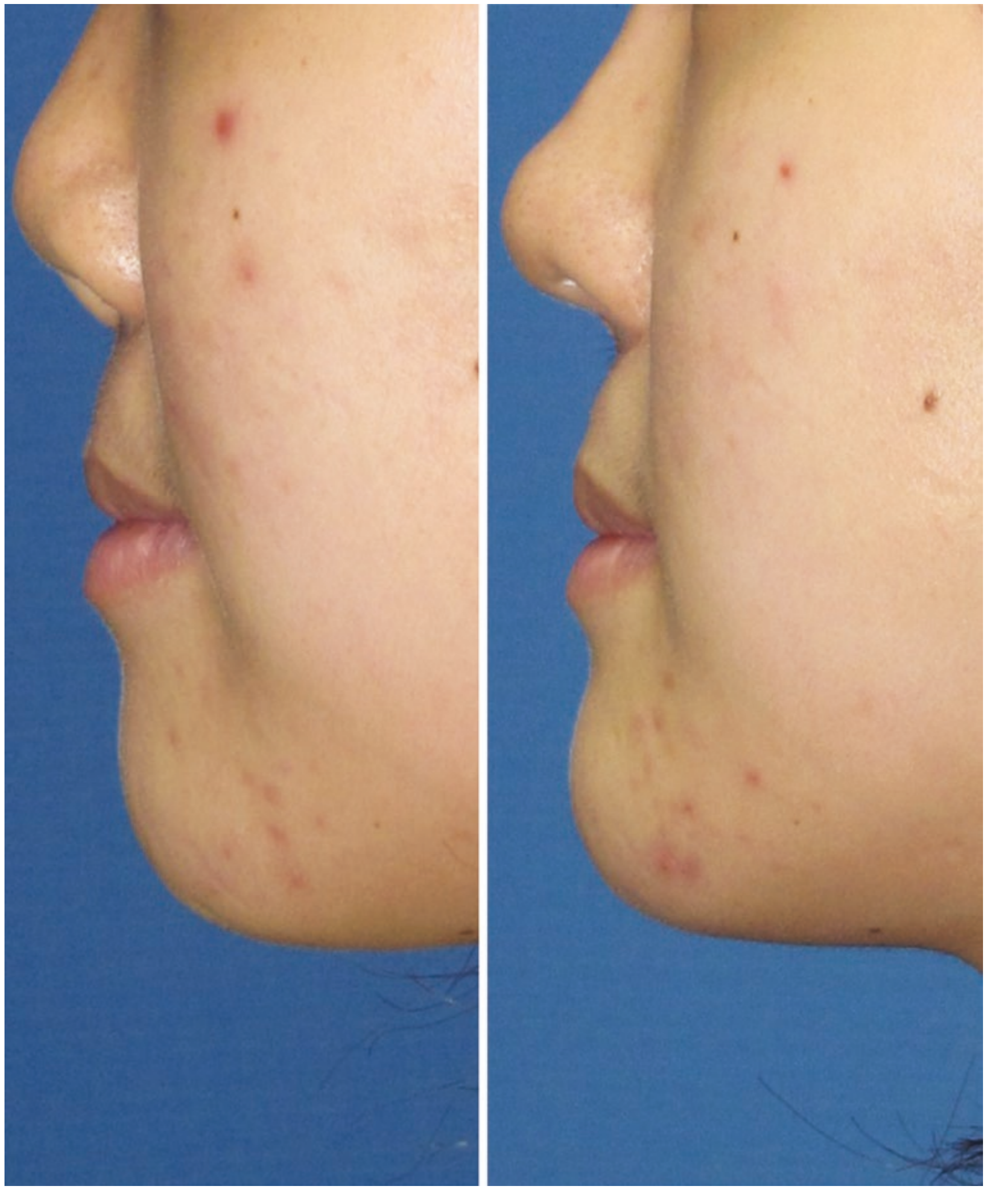

Fig. 22.22 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (rib graft for nasal tip rotation and projection and nostrils narrowing)

−1.01% loss of rotation, respectively), which would indicate less cranial/caudal support provided by the columellar strut (Sawh-Martinez et al. 2019; Toriumi 2019). Owing to the more rigid fixation of the septal extension graft to the caudal septum compared with the columellar strut graft, one would expect less loss of tip projection in patients treated with septal extension graft procedure (Sawh-Martinez et al. 2019; Toriumi 2019). Interestingly, the loss of tip projection was larger in the caudal septal extension graft group (−2.2% loss of tip projection) compared with the columellar strut group (−2.2% versus −1.7% loss of tip projection, respectively), but with no significant difference between groups. This could be justified by the surgeon who probably adopted clinical criteria to decide whether a septal extension graft or a columellar strut graft was used, that is, a weaker native nasal structure required the more rigid septal extension graft procedure, and a stronger structure required less rigid fixation with a columellar strut graft procedure (Sawh-Martinez et al. 2019; Toriumi 2019). Criteria that would influence the selection of a columellar strut graft procedure include the long strong medial crura, small availability of grafting tissue, and adequate or excess tip projection or minimal need to change tip position (Toriumi 2019, 2006). Criteria that would influence the selection of a septal extension graft procedure include the short weak medial crura, an under-projected nasal tip, thicker skin, and weaker tip cartilages (Toriumi 2019, 2006). Overall, if the open approach is used and the nasal septum is approached by dissecting between the medial crura, major support mechanisms of the nose are disrupted, and the nasal tip support is compromised. To rebuild appropriate nasal tip structural support, it has been recommended a systematic placement of septal extension graft to stabilize

Fig. 22.23 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (septal extension graft)

Fig. 22.24 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (septal extension graft)

Fig. 22.25 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (septal extension graft)

Fig. 22.26 Patient with bilateral cleft nasal deformity treated with secondary rhinoplasty (septal extension graft)

the nasal base and minimize postoperative loss of tip projection (Toriumi 2019, 2006). When it is needed to change nasal length, increase or decrease tip rotation, or alter the alar/columellar relationship, it has been recommended to dissect between the medial crura to access the caudal septum plus placement of a septal extension graft (Toriumi 2019, 2006).

A further critical indication for adopting a septal extension graft is to properly control nasal tip rotation. If a columellar strut graft is positioned and nasal tip projection is increased, there is a predisposition for the nasal tip to rotate as the cutaneous envelope pushes back on the projecting nasal tip and forces the tip cartilages cranially (Toriumi 2019). This is demonstrated by the three-dimensional imaging-based outcome study (Sawh-Martinez et al. 2019), with increases in tip rotation from preoperative time to 6 weeks postoperatively of 11.2° and 0.5° for the columellar strut graft group and the septal extension graft group, respectively (Sawh-Martinez et al. 2019). To prevent excessive tip rotation as tip projection is increased (>2 mm), it has been recommended the adoption of a triangularly shaped septal extension graft with the wider margin oriented superiorly to hold the tip down (caudal) (Toriumi 2019). This septal extension graft with a triangular shape could better resist the tension of the cutaneous envelope during the healing process as it pushes back on the nasal tip cartilages. Alternatively, if significant tip rotation is desired, the septal extension graft can be oriented as a rectangular graft or with the longer margin oriented inferiorly (Toriumi 2019).

Considering the brow-tip aesthetic line, the transition from the midnasal vault to the nasal tip should show a slight divergence at the nasal tip as it approaches the alar margins. Disproportionate fullness in the supratip region could create a bulbous appearance to the nasal tip area, creating unfavorable shadowing and unpleasant appearance. Fullness in the supratip region may be due to lower lateral cartilages (lateral crura) that have an excessive vertical height or are cephalically positioned. Such supratip fullness should be eliminated to create a supratip shadow and resultant attractive nasal tip. The cephalic trim can be adopted to refine the nasal tip and decrease supratip fullness by reducing the vertical height of the lower lateral cartilages. Cephalic trimming of large lower lateral cartilages is helpful in reducing the large nasal tip commonly seen in patients with bilateral secondary cleft nose deformity. Importantly, this surgical maneuver should be indicated mainly for specific patients with convex areas leading to domal fullness as any over-resection could result in weakening of the lower lateral cartilages leading to alar deformities such as pinched tip, alar retraction, nasal tip asymmetry, nasal tip collapse, or external nasal valve collapse. Avoiding these problems requires preservation of a smooth uninterrupted transition between the nasal tip and alar lobule. Alar batten grafts are placed in a pocket just medial to the supra-alar crease as a prophylactic maneuver to prevent collapse of the lateral wall (i.e. external nasal valve collapse) and the resulting nasal airway obstruction; the exact position of the graft is determined by the site of maximal collapse. Alternative methods (e.g., dome suturing or trimming of the anterior septal angle as it approaches the domes) have also been adopted to refine the nasal tip and reduce peridomal fullness (supratip fullness) without weakening the lower lateral cartilages.

When properly indicated, the lower lateral cartilages are separated from the upper lower lateral cartilages at the scroll area. The cephalic portion of the lower lateral cartilages is trimmed, that is, resection of convex areas leading to domal fullness. The portions of the lateral crura to be trimmed can be injected to facilitate dissection with no disruption of the nasal lining. During trimming, proper size of the lower lateral cartilage should be left intact (called conservative cephalic trim): at least 8–10 mm medially and 5–7 mm laterally at the domes. Five different types of cephalic trim techniques have been described for modification of the cephalic border of the lower lateral cartilages (Nagarkar et al. 2016):

- Type IA: No cephalic trim.
- Type IB: No cephalic trim, but the separation of upper and lower lateral cartilages.
- Type II: Limited cephalic trim (only the scroll area is resected).
- Type III: The cephalic margin of the lateral crura is resected with a remnant inferior rim strip of at least 6 mm, and the vestibular skin is not resected.
- Type IV: A cephalic strip of cartilage is removed from the middle crura in addition to the lateral crura; a 6-mm rim strip of cartilage is left intact inferiorly, and the vestibular skin is not resected.
- Type V: The cephalic portion of the lateral crus is incised, leaving a 6-mm strip of caudal cartilage intact; it is turned over and sutured to the caudal lateral crura (called lower lateral crural turnover flaps).

Some patients could present with the lateral crura in a cephalic orientation instead of the more normal oblique orientation approximately 45° off midline. Cephalically positioned lateral crura create excess vertical supratip tip fullness. The lateral crura can be dissected from the underlying vestibular skin. Lateral crural strut grafts can be sutured to the undersurface of the lateral crura. The lateral crura can be then repositioned into the new, caudally positioned pockets to correct the cephalic positioning (Gunter and Friedman 1997).

The contribution of the alar rims to the alar-columellar relationship, nasal tip support, and patency of the external nasal valve has been relevant for rhinoplasty procedure (Gunter and Rohrich 1992; Unger et al. 2016; Rohrich et al. 2017a; Rohrich and Ahmad 2011, 2016; Rohrich and Afrooz 2017, 2019). It is paramount to properly identify the deformities of the alar rims such as notching or retraction, soft triangle deformities, malposition of the lateral crura, and external valve collapse (Rohrich and Ahmad 2011, 2016; Rohrich and Afrooz 2017, 2019). A number of techniques serve to strengthen and modify the lateral crura and alar rims including the lateral crural horizontal mattress sutures

(Gruber et al. 2005a, b), lateral crural strut grafts (cartilage grafts with different designs placed in the undersurface of lower lateral cartilage) (Gunter and Friedman 1997; Cochran and Sieber 2017), batten grafts (curvilinear cartilage grafts placed into a precise pocket at the point of maximal lateral wall collapse or supra-alar pinching) (Guyuron 2008; Toriumi et al. 1997; Tardy and Garner 1990), lower lateral crural turnover flaps (the cephalic cartilage flap is turned over onto the remnant caudal cartilage; the two-layer lower lateral cartilages should appear flat with a gentle cephalic orientation) (Janis et al. 2009; McCollough and Fedok 1993), and alar contour grafts (cartilage grafts measuring 2–3 mm wide and approximately 15 mm long placed along the alar rims into vestibular pockets) (Rohrich et al. 2002a). If the lower lateral cartilages have been damaged in previous rhinoplasty procedures, a whole new alar structure can be composed of septal or costal cartilage (called as "golden arch") (Wolfe et al. 2016).

Cephalic rotation of the nasal tip can be achieved by means of direct and indirect surgical methods (Afrooz et al. 2019):

- Cephalic trim (Nagarkar et al. 2016)
- Caudal trim of the upper lateral cartilages (Hazani et al. 2013; Pensler 2009)
- Caudal septal trim (Rohrich and Afrooz 2018b)
- Lateral crural shortening (transection and overlap of the lateral crura or excision of a segment of the lateral crura, followed by an end-to-end repair) (Kridel and Konior 1991)
- Lateral domal relocation (horizontal mattress transdomal suture placed to recreate the domes in a new position) (Kridel et al. 1989)
- Tip rotation suture (Guyuron and Behmand 2003b; Baker 2000)

Nasal tip suturing techniques are powerful tools which present three endpoints (Dayan and Rohrich 2020):

- Caudal portion of the tip should be higher than the cephalic portion
- Lateral crura should be straight
- Lower lateral complex should be everted upward

Key suturing techniques have been adopted to improve position and shape of the nasal tip (Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015; Gruber et al. 2008, 2010):

- Medial crural suture
- Middle crura suture
- Transdomal suture
- Interdomal suture

Medial crural sutures can be used to address a number of deformities, such as correct medial crural asymmetries, reduce flaring, control the width of the columella, increase tip projection, and secure a columellar strut graft or a septal extension graft. Regularly, the medial crural sutures are the first of the tip suturing techniques performed, as the medial crural-columellar strut complex acts as a relevant element of stability in the nasal tripod (Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015; Gruber et al. 2008, 2010). This technique increases tip strength and projection by recruiting medial crura anteriorly toward the anterior septal angle using a three-suture method:

- Internal medial footplate suture
- Lower intercrural
- High intercrural

The middle crura suture is applied to control the angle of divergence between the middle crura. By reducing the angle of divergence between the middle crura, this suture could increase nasal tip projection, increase tip support, narrow the anterior columella, and reduce the interdomal distance. The middle crura suture can also have additional effects on the infratip lobule size. Depending on the length of the columellar strut graft or septal extension graft, the middle crura suture could incorporate the graft (Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015; Gruber et al. 2008, 2010).

The transdomal suture is adopted to modify nasal tip shape and contour of the lateral crura; this suture slightly increases nasal tip projection and the sharper contour of the apex of the dome increases tip definition. A horizontal mattress suture is placed from medial to lateral across the dome region. Placement of these sutures at differential levels can be applied to correct asymmetries in the domes. It is important to be cautious in over-tensioning a transdomal suture as this can result in an excessive concavity adjacent to the domes plus an excessive nasal tip projection. The transdomal suture should then be tightened incrementally to accomplish the desired tip shape. Meticulous cranio-caudal placement of the suture is also relevant, as this can have a substantial impact on rotation of the lower lateral cartilages (Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015; Gruber et al. 2008, 2010).

The interdomal suture is frequently adopted to decrease the angle of domal divergence, narrow the tip-defining points, increase nasal tip projection, and refine the infratip lobule region. It is placed as a loop suture, that is, from lateral to medial through one dome and then again from medial to lateral through the opposite dome. Alternatively, a figure-of-eight suture can be applied to properly align the domes as required. The interdomal suture should also be tightened incrementally to achieve the desired interdomal distance without overtightening. Cephalo-caudal placement of the interdomal suture could also have a substantial impact on the positioning of the domes and lateral crura elements (Guyuron and Behmand 2003b; Behmand et al. 2003; Cingi et al. 2015; Gruber et al. 2008, 2010).

Narrowing the dome angle with dome sutures could result in the descent of the caudal margin of the lateral crus below the cephalic margin and concavity of the lateral crus. This deformity is even more likely to occur when a single transdomal suture is used to narrow the tip as it traverses both domes at an oblique angle, displacing the caudal margin of the lateral crus below the cephalic margin. The combination of these transdomal suture-derived structural changes can result in a pinched tip and notching of the alar margin. Two separated transdomal sutures are then naturally preferred to avoid pinching the domes together. After placing the transdomal sutures, the support and contour of the alar margins can be reconstituted by using alar rim grafts to re-create the elevated ridge along the alar margin that transitions from nasal tip to alar lobule. Alar rim grafts (thin, soft cartilage grafts measuring 12–15 mm and 2–3 mm in length and width, respectively) are placed into pockets along the caudal margin of the infracartilaginous incision (Rohrich et al. 2002a). After placement of the alar rim graft into the pocket, a suture is placed surrounding both soft tissue and graft to avoid fracturing the cartilage. The alar rim grafts re-create the elevated ridge between the tip and alar lobule as well as fill the space created by any concavity of the lateral crura and/or descent of the caudal margin of the lateral crura. A particular combination of maneuvers (i.e., conservative cephalic trim, dome-binding sutures, and alar rim grafts) can successfully correct any bulbous deformity and create nasal tip contour as preferred. Disproportional alar rim grafts, that is, thicker or longer grafts, could leave a visible irregularity in the nasal tip region postoperatively. Additionally, alar rim grafts could produce an increase in the size of the nostrils and flaring of the ala, with a more frequent need for alar base reduction to decrease the alar flare and nostril size.

Nasal tip grafts may be required to achieve a refined nasal tip in patients with thick skin. Overall, placement of nasal tip grafts over the tip-defining points could increase nasal tip projection and definition, whereas placement of nasal tip grafts at and below the tip-defining points will increase projection and enhance the volume of the infratip lobule (Sheen 1975; Peck 1983; Rohrich and Deuber 2002; Rohrich and Afrooz 2018a; Gunter and Rohrich 1992). The main variations in tip grafting include infralobular (Sheen 1975), onlay (Peck 1983), cap, butterfly (Rohrich and Deuber 2002; Rohrich and Afrooz 2018a), or combined (Gunter and Rohrich 1992). Tip grafts can be designed in various shapes, ensuring sharp edges beveled to avoid visibility in long-term follow-up, that is, avoid a visible “tombstone” appearance through skin after many years of healing and scar contracture that shrinks the cutaneous envelope over the grafted nasal tip. Any type of tip graft that projects exceeding the existing domes is at risk of visibility postoperatively, regardless of the type of skin or cutaneous thickness. If the tip graft projects more than 3 mm above the domes, onlay lateral crural grafts can be used to create a smooth transition from the lateral margin of the tip graft to the lateral crura. A sheet of gently crushed cartilage or perichondrium tissue can also be placed over the composite graft (tip graft plus onlay lateral crural graft) to further camouflage the grafts, ensuring a smooth tip contour postoperatively.

A further important element in rhinoplasty is the soft-tissue triangle regions. The unique anatomy and microanatomy of the soft-tissue triangle (Dowlatshahi et al. 2020; Campbell et al. 2017) make it prone to notching (iatrogenic alar retraction) postoperatively (Alexander et al. 2013; Kao and Davis 2019; Campbell et al. 2017; Totonchi and Guyuron 2016). An imprecise infracartilaginous incision in the vestibular surface of the soft-tissue triangle can result in notching. Placement of a marginal incision too close to the alar rim (marginal incision) and not cephalad enough within the copula of the soft-tissue triangle results in a more external scar location that notches the soft-tissue triangle as it contracts postoperatively (Campbell et al. 2017). Based on cadaveric studies, it was determined where incisions within the soft-tissue triangle could be made safely; three zones within the soft-tissue triangle were defined (Ali-Salaam et al. 2002):

- Muscle caudal to the lower lateral cartilages
- Interval dermis-to-dermis contact area
- Muscle interdigitating with dermis at the nostril rim

An approach was purposed to proactive correction and prevention of soft-tissue triangle notching (Campbell et al. 2017):

- Precise high-infracartilaginous soft-tissue triangle incision placement and meticulous dissection (incision placed more cephalad within the copula and minimizing tension during closure)
- Providing internal support with cartilage grafting (extended alar contour graft) if needed
- Closure of dead space under the soft-tissue envelope using morselized cartilage (only if and when a soft-tissue triangle indentation is present at the time of closure)
- Avoiding undue tension during closure (lateral and medial lining closure to avoid undue tension; the area of the soft-tissue triangle is not suture closed and is packed with morselized cartilage as indicated or bacitracin-soaked Surgicel)

- Providing external support postoperatively (5 × 5-mm pieces bacitracin-soaked Surgicel inserted into the vestibular surface of the soft-tissue triangle along the area of the incision that has been left open and left in place for 1 week postoperatively)

22.5.6 Alar Base Repositioning

Addressing the malpositioned alar base is often one of the final stages of secondary rhinoplasty (Fig. 22.21 and 22.22). Alar base-focused surgery has been performed to address alar flaring, large nostril size, excessive width of the nasal base, and alar base or nostril asymmetries (Rohrich et al. 2017a; Ponsky and Guyuron 2010; Guyuron and Behmand 1996; Losquadro et al. 2012).

In the cleft lip nasal deformity, the alar base can be displaced in the inferiorly, laterally, and posteriorly, respectively (i.e., *x*, *y*, and *z* axes, respectively). Anterior positioning, that is, along the *z* axis, can be achieved with skeletal augmentation (surgical-derived maxillary mobilization or paranasal augmentation with cartilage, fat or bone graft tissue or porous polyethylene implant).

It has been documented that with growth and development the cleft side alar base drifts laterally (Liou et al. 2004; Knight et al. 2016). Recent study emphasized that alar base should not be medialized unless the caudal septum is straightened (Isaac et al. 2019). Overall, techniques that medialize the alar bases include sill excision, vestibular excision, V-Y advancement, alar cinch, and pyriform ligament release (Rohrich et al. 2017a; Kridel and Castellano 2005; Bohluli et al. 2012a, b; Adamson 2005; Cinelli 1961; Ship 1975; Tardy et al. 1993; Gilbert 1996; Foda 2007, 2011; Warner et al. 2010; Ponsky and Guyuron 2010; Guyuron and Behmand 1996; Gruber 2002; Gruber et al. 2009a, b; Hamilton 2014; Oh et al. 2010; McKinney et al. 1988; Constantian 1989; Matarasso 1996; Bennett et al. 2005; Yen et al. 2020). Different patterns of Z-plasty, vertical lenticular excision, or V-Y advancement (considering the degree of displacement of the alar base) cane be adopted for repositioning of the alar base in the *x* and *y* directions. An alar cinch suture can also be placed to the periosteum of the anterior nasal spine region, anterocaudal septum, pericolumellar soft tissue or bilateral alar base region.

Nasal width is determined by interalar distance, that is, the distance between the lateralmost point on each ala (Bernstein 1972; Crumley 1988; Ellis and Dindzans 1987; Brissett and Sherris 2000; Guyuron and Behmand 1996). Alar flare is present when the alar rim projects farther laterally than does the alar base such that the interalar distance is greater than the base width; in other words, the projection of the alar rim determines the width of the lower third of the nose. If no alar flaring exists, interalar distance is equal to base width; in other words, nasal width is set by the position of the alar base. Ethnic patterns should also be considered as, for examples, a limited flare (e.g., 2 mm in the Caucasian woman) can be considered as normal and often be desirable (Rohrich et al. 2017a). Interalar distance can be increased by lateral malposition of the alar bases and/or alar flare. As alar flare is determined by the nasal tip projection, the tip rotation, and the length and strength of the lateral crura and alar rims, the final decision to implement alar flare reduction happens just before wound closure. Classification of three alar flare types (i.e., where the most lateral point along the alar rim occurs relative to the level of the sill-base junction on basal view) and excision patterns have been described (Rohrich et al. 2017a):

- Type 1: the lateralmost point on the rim is below the sill-base junction such that a straight line from sill-base junction to the lateralmost point on the ala will slant inferiorly (excision pattern should not extend far above the base along the alar-facial groove).
- Type 2: the line slants is horizontal (excision pattern extends farther up onto the lobule along the alar-facial groove).
- Type 3: the line slants superiorly from sill-base junction to lateralmost point along the alar rim (a larger excision is indicated for reduction; tip modification and/or sill excision may be indicated to achieve desired narrowing of the interalar distance).

Alar base reduction is an extremely sensitive approach to decrease the alar flare and nostril size; if not performed precisely, an alar base reduction could result in visible scars and deformities such as an unpleasant and visible scar, small or asymmetric nostrils, notched nostril sill, or altered alar insertions.

22.5.7 Nasal Bone Osteotomy

Nasal osteotomies have primarily been adopted to narrow a widened bony vault, close an open roof deformity, or straighten deviated nasal bones. External or internal approaches can be adopted to perform different designs of osteotomies or osteoectomy (Nam et al. 2019; Gerbault et al. 2018; Gruber et al. 2016, 2007b; Gruber 1995; Harshbarger and Sullivan 1999, 2001; Guyuron 1998; Ghanaatpisheh et al. 2015; Rohrich et al. 2001, 2003, 1997; Gryskiewicz and Gryskiewicz 2004; Zholtikov et al. 2020; Locketz et al. 2020; Becker et al. 2000; Rohrich and Adams 2000), including:

- Medial and lateral osteoectomies
- Medial and transverse osteotomy (medial, paramedial, medial oblique, and lateralized medial oblique osteotomies)

- Midlevel or intermediate osteotomy (high, midlevel, and low intermediate osteotomies)
- Lateral or base osteotomy (low-to-low, low-to-high, high-low-high osteotomies)

The bone chisel scraping osteoectomy technique was proposed for lateral and medial osteotomies as an attempt to manage nasal bone deformities while diverse shortcomings of the conventional methods could be overcome (Çakr et al. 2016; Lykoudis et al. 2018). In this surgical philosophy, the nasal bridge is narrowed by the removal of bone from the open roof region using two different narrow neck 8-mm curved chisels; the bone segments are then mobilized. This new concept in nasal bones repositioning requires further investigation.

Medial osteotomies are performed at the medial edge of the nasal bone, separating the nasal bones from the osseous nasal septum, with common indications for adoption of medial osteotomies (Locketz et al. 2020):

- Assist the mobilization of the nasal bony sidewall
- Aid the control in fracturing from the upper portion of a lateral osteotomy
- Widen an overly narrowed bony vault

Lateral or base osteotomies continuous (osteotome) or discontinuous (perforating; percutaneous with a 2-mm osteotome) are performed at the lateral portion of the nasal bone along the nasofacial junction (i.e., the transition zone of thinner bone at the nose–cheek junction), with common indications for adoption of lateral ostotomies (Locketz et al. 2020):

- Narrow a wide bony vault
- Close an open roof deformity after hump reduction
- Mobilize a deviated nasal pyramid (straightening the deviated nose)
- Increase the width of the nasal bones (nasal vault narrowed with previous surgery or trauma)

Overall, a "high" location of a lateral nasal osteotomy is more anteromedial in the osseous vault, and a "low" trajectory is more posterolateral. The lateral nasal osteotomy is usually finished anterior to the medial canthus and caudal to the frontomaxillary suture. Different patterns of lateral nasal osteotomy have been described (Webster et al. 1977; Dobratz and Hilger 2010):

- Low-low-low line: initiated low at the inferiormost aspect of the pyriform aperture; extended cephalically along a low line where the ascending processes of the maxilla is ending; and finalized at or beyond the nasofrontal suture (low).
- Low-low-high line: initiated low at the inferiormost aspect of the pyriform aperture; extended cephalically along a low line where the ascending processes of the maxilla is ending; and curved superiorly and anteriorly in a high line into the thinner aspect of the nasal bone, terminating at the level of the medial canthus.
- High-low-high line: initiated high on the pyriform aperture (slightly above the attachment of the inferior turbinate to preserve the opening of the nasal aperture [preservation of a triangular strut of the maxillary bone named as Webster's triangle], attenuating serious compromising nasal airway functioning); continued cephalically along a low line within the nasofacial groove until it reaches the level of the inferior orbit; and curved superiorly and anteriorly in a high line into the thinner aspect of the nasal bone, terminating at the level of the medial canthus.

Superior or transverse osteotomies connect medial and lateral osteotomies between the medial canthus and the apex of the nasal dorsum. Midlevel or intermediate osteotomies run in a course roughly midway up the nasal sidewall paralleling the mid-portion of the lateral osteotomy path, with common indications for adoption of intermediate osteotomies (Locketz et al. 2020):

- Narrow an overly wide bony vault
- Correct the deviated nose with asymmetric sidewall lengths
- Straighten an excessively concave or convex nasal bone

Overall, lateral osteotomy addresses the width of the nasal base, whereas medial osteotomy addresses the width of the nasal dorsum. Osteotomy choice should be tailored based on what each particular nasal deformity requires (Gerbault et al. 2018; Gruber et al. 2016, 2007b; Gruber 1995; Harshbarger and Sullivan 1999, 2001; Guyuron 1998; Ghanaatpisheh et al. 2015; Rohrich et al. 2001, 2003, 1997; Gryskiewicz and Gryskiewicz 2004; Zholtikov et al. 2020; Locketz et al. 2020). The decision of osteotomy can be based on two parameters: nasal dorsum and nasal base width. There are three types of noses in terms of nasal bone width (Gruber et al. 2016):

- Type I, broad base
- Type 2, broad base and dorsum
- Type 3, broad dorsum only

To minimize bleeding and spicule formation, one should avoid the triangular area in the medial aspect near the nasion (cephalic central part a region 15° off the midline) while performing the medial osteotomy; this region is composed of dense bone (3–6 mm in thickness) and it is rich with blood vessels (Gruber et al. 2016; Harshbarger and Sullivan 1999, 2001). The typical medial osteotomy runs parallel to the nasal septum and goes straight through into this region. After fracturing the osteotomized nasal bone segment, one can visually perceive or palpate an unwanted spicule of bone which is difficult to repair. Variations of medial osteotomy such as the medial oblique osteotomy can avoid this region (Gruber et al. 2016). With the exception of the triangular dense zone at the cephalic portion of the nasal bones, the nasal bones are basically thin plates attached to different regions (Gruber et al. 2016; Harshbarger and Sullivan 1999, 2001):

- Medially to the nasal dorsum
- Laterally to the maxilla
- Cephalically to the nasofrontal suture (area adjacent to the nasion)

It has been recommended to approach the nasal bones as plates that need to be surgically released from their medial and lateral attachments to be mobilized into a target- or condition-specific position. By leaving a small cephalic bony attachment or an intact periosteum deep into the nasal bone plates, the osteotomized bone plates would have a greenstick quality and would not collapse (Gruber et al. 2016). Importantly, nasal osteotomies that proceed too far cranially into the frontal bone region can result in a rocker deformity, that is, the superior nasal bone is pushed outward when the inferior nasal bone is medialized (Azizzadeh and Reilly 2016; Toriumi and Hecht 2000; Harshbarger and Sullivan 1999, 2001).

A surgical-focused cadaver-based study evaluating three parameters, that is, achieving desired cutting pattern, completeness of mobilization of the osteotomized nasal fragment, and whether a continuous cut was obtained, had three main conclusions (Gabra et al. 2014):

- Without prior paramedian osteotomy, high-low-high osteotomy can result in a greenstick fracture superiorly and incomplete mobilization of the bony nasal sidewall. Necessary digital pressure does not always determine a reliable and controlled cut and can generate nasal bone collapse consequent to mucosal tearing.
- When high-low-low osteotomy is intended, it was suggested a sequence for osteotomy: paramedian osteotomy followed by percutaneous transverse osteotomy and the lateral osteotomy. Without transverse osteotomy, cutting line tends to deviate into a higher pattern as the osteotomy line approaches the medial canthus.
- In extremely crooked noses, a transverse osteotomy of the central segment, that is, the portion of the nasal bone between the paramedian osteotomies, does not result in the collapse of the nasal pyramid and is considered reliable in order to mobilize the nose into midline.

The timing of the nasal osteotomies within the time frame of the entire rhinoplasty procedure could vary depending on the surgeon's preference as well as the type of nasal deformity being surgically managed. For nasal osteotomies, the tactile and auditory feedback guide the surgeon during the procedure. After the unilateral or bilateral osteotomies are completed, the nasal bone is greenstick fractured with gentle digital pressure between the thumb and forefinger until the osteotomized bone segment is positioned in the desired location. Each nasal bone side can be differentially aligned to achieve a more symmetric position of bone segments. Importantly, nasal osteotomies, no matter how they are performed, involves a steep learning curve. It has been described that is not easy to palpate where osteotomes are located even though they all come with a guard; it involves a very controlled grip by the surgeon's hands and kinetic comprehension of where the osteotome is with the relationship to the surrounding structures such as maxillary bone and medial canthus (Gruber et al. 2018). Moreover, there is no single technical modality to fully ensure that nasal osteotomy will totally spare the branches of angular artery, avoid bleeding, and result in postosteotomy irregularities (e.g., Rocker deformity), fragmented bone pieces, ecchymosis, and edema. Recent methods using bone osteotomy and shaping under direct vision such as piezoelectric instrumentation have been adopted as an attempt to attenuate these potential drawbacks (Gerbault et al. 2016; Robiony et al. 2007, 2019; Pribitkin et al. 2010; Ghassemi et al. 2013; Robiony 2015; Tirelli et al. 2015; Greywoode and Pribitkin 2011; Pribitkin and Greywoode 2013; Hjelm et al. 2020; Tsikopoulos et al. 2020; Ozucer and Özturan 2016).

22.5.8 Inferior Turbinate

The head of the inferior turbinate is large and extremely dynamic, and it is located at the critical internal valvular area. Compensated enlargement of the inferior turbinate should be corrected concomitantly during septoplasty. The use of a speculum promotes direct visualization of a hypertrophied inferior turbinate, facilitating turbinoplasty such as total turbinectomy, partial turbinectomy, submucosal resection, out-fracture technique with lateralization of the turbinate, cryosurgery, resection using a microdebrider, and turbinate micro-fragmentation, electrocautery or radiofrequency ablation, and laser coblation. Radical turbinoplasty (full turbinectomy or radical turbinectomy) should be avoided, whereas the other conservative methods present particular advantages and disadvantages (Downs 2017; Bhandarkar and Smith 2010).

22.5.9 Nasal Airway

Different studies have reported a high prevalence of nasal obstructive symptoms in children and adults with cleft lip and/or cleft palate based on the type and severity of the cleft (Sobol et al. 2016; Morén et al. 2013; Reiser et al. 2011; Mani et al. 2010; Frank-Ito et al. 2019; Marcus et al. 2019). A recent survey (nasal obstructive screening questions) completed by parental proxy for 176 children with cleft lip and/or cleft palate (aged 9.9–17.0 years at the time of study) and 333 unaffected age-matched children showed that nasal obstructive symptoms were more frequently reported in patients with cleft lip with cleft palate compared with unaffected children; children who had isolated cleft lip and isolated cleft palate were not statistically different from unaffected children; patients with unilateral cleft lip with cleft palate were found to be more severely affected than bilateral cases; nasal obstruction was observed in early childhood, and severity worsened in adolescence (Sobol et al. 2016). A further investigation encompassed 83 adult patients with unilateral cleft lip and palate (mean of 37 years after the first cleft lip operation) (Morén et al. 2013). Patients reported a higher frequency of nasal symptoms compared with the healthy group (age-matched group of 67 noncleft controls): nasal obstruction (81% versus 60%, respectively) and mouth breathing (20% versus 5%, respectively). Patients also rated their nasal symptoms as having a more negative impact on their daily life and physical activities than the healthy group. Nasal examination revealed higher frequencies of nasal deformities among patients, but no positive correlation was found between nasal symptoms and severity of findings at nasal examination (Morén et al. 2013).

In any secondary cleft nose rhinoplasty, the procedure needs to preserve or improve the nasal airway as needed. History taking should rule out the presence of nasal allergy, which is not a surgical problem. Anatomic causes of airway obstruction include the alar rims and lateral nasal walls, deviated nasal septum, inferior turbinate hypertrophy, decreased internal nasal valve angle, and narrowed nasal bones (Wright et al. 2020; Teichgraeber et al. 2016; Ghosh and Friedman 2016; Frank-Ito et al. 2019; Marcus et al. 2019). Narrowing of the intranasal airway due to collapse of nasal midvault, septal deviation, hypertrophied inferior turbinate, and/or an abnormality of the nasal valve increases intranasal resistance, causing nasal obstruction. A combination of surgical maneuvers could proposedly be employed to address a unilateral or bilateral nasal airway obstruction, including nasal midvault-focused intervention with spreader graft or flap, septoplasty with septal resection and medialization, and turbinoplasty with inferior turbinate reduction.

22.5.10 Closure

At the end of the surgical procedure, the transcolumellar incision is meticulously reapproximated with 6-0 nylon interrupted sutures. Interrupted absorbable sutures are placed in the infracartilaginous incision. Trans-septal absorbable sutures are also applied to coapt the mucosal flaps, reduce hematoma formation, keep the repositioned septal structures in the midline, and prevent synechiae. Alternatively, internal paraseptal splints can be adopted. Nasal packing of the posteriormost and superiormost portions of the nasal airway (i.e., synthetic sponge, synthetic packing material, or gauze with antibiotic ointment in the nasal cavity), external taping (overlapping fashion along the dorsum and to the level of the supra-tip breakpoint) (Belek and Gruber 2014; Momeni and Gruber 2016), and dorsal nasal splinting with an extension to the forehead are also placed immediately after cutaneous closure.

22.6 Ethnic Consideration

The surgeon treating skeletally mature patients with nose-related concerns is frequently challenged with a request to aesthetically enhance the shape, the contour, and the dimensions of nose. The surgeon should then be sensitive not only to norms of the typical Asian and Caucasian noses (Farkas et al. 2005) but also how patient expectations are different between racial types and how to surgically manage each racial-specific nasal structure (Rohrich and Bolden 2010; Park et al. 2015; Suhk et al. 2015; Li et al. 2014; Han et al. 2004; Letourneau and Daniel 1988; Zingaro and Falces 1987; Leong and White 2004; Gruber et al. 2004; Toriumi and Pero 2010; Shirakabe et al. 2003; Park and Jin 2012; Zhang et al. 2021; An et al. 2021; Na and Jang 2020; Wong et al. 2017; Tiong et al. 2014; Won and Jin 2012; Huang and Liu 2012; Jin and Won 2016, 2011; Kim and Daniel 2012; Jayaratne et al. 2014; Jang and Yi 2014; Jang and Alfanta 2014; Lee and Song 2015; Moon and Han 2018; Jang 2018; Lao et al. 2021; Kim and Jeong 2019, 2020).

To define the spectrum of ethnic nasal variations (Aung et al. 2000), three broad morphological types have been applied (Park et al. 2015; Suhk et al. 2015; Li et al. 2014):

- Leptorrhine (“tall and thin”) nose
- Mesorrhine (“intermediate”) nose
- Platyrrhine (“broad and flat”) nose

Unlike Caucasian noses, anatomical norms for Asian noses are a flatter dorsum, more triangular shape on the frontal view, wider alar width, flared nasal base (wider-thanaverage nostrils), rounder tip and alae, more-retrusive columella, short nose, and less-projecting nose (Park et al. 2015; Suhk et al. 2015; Li et al. 2014; Han et al. 2004; Letourneau and Daniel 1988; Zingaro and Falces 1987; Zhang et al. 2021; An et al. 2021; Na and Jang 2020; Wong et al. 2017; Tiong et al. 2014; Won and Jin 2012; Huang and Liu 2012; Jin and Won 2016, 2011; Kim and Daniel 2012; Jayaratne et al. 2014; Jang and Yi 2014; Jang and Alfanta 2014; Lee and Song 2015; Moon and Han 2018; Jang 2018; Lao et al. 2021; Kim and Jeong 2019, 2020). Anatomical features of Asian noses encompass thick sebaceous skin, abundant subcutaneous soft tissue, and weaker cartilages (the alar cartilage is small and weak; nasal septal cartilage is very thin) (Park et al. 2015; Suhk et al. 2015; Li et al. 2014; Han et al. 2004; Letourneau and Daniel 1988; Zingaro and Falces 1987; Zhang et al. 2021; An et al. 2021; Na and Jang 2020; Wong et al. 2017; Tiong et al. 2014; Won and Jin 2012; Huang and Liu 2012; Jin and Won 2016; Kim and Daniel 2012; Jayaratne et al. 2014; Jang and Yi 2014; Jang and Alfanta 2014; Lee and Song 2015; Moon and Han 2018; Jang 2018; Lao et al. 2021; Jin and Won 2011). Surgical goals should then be patient-tailored to the ethnicity and culture of each particular patient. For example, a recently proposed algorithm for Western rhinoplasty (often reduction in nature with "too big, too high, or droopy" as a typical preoperative complaint) was a dorsum-first, tip-second surgical sequence, while the proposed algorithm for Eastern rhinoplasty (often augmentation in nature; "too small, too short, or upturned" as a typical preoperative complaint) was a tip-first and dorsum-second surgical sequence (Lao et al. 2021).

22.6.1 Nasal Dorsum

Unlike Caucasian noses, the nasal dorsum of Asian nose is wide, low, and flat (Park et al. 2015; Suhk et al. 2015; Li et al. 2014; Han et al. 2004; Letourneau and Daniel 1988; Zingaro and Falces 1987; Kim and Jeong 2019, 2020).

The ideal vertical position of the nasion is between the supratarsal fold and the lash line of the upper eyelid (Aiach et al. 2002). However, the ideal position for an Asian nose is to be at the level or lower than the lower margin of the upper eyelid in forward gaze (Suhk et al. 2015). Most Asian rhinoplasties need dorsal augmentation to heighten the low dorsum (Suhk et al. 2015). Pure dorsal augmentation moves the positional height of the radix upward, providing an elongated appearance to the nose as well as an appearance of relative tip deprojection (Suhk et al. 2015).

Some factors such as facial width, nasal length, nasal tip sharpness, and skin thickness could influence the ideal width of the nasal bony vault. Like happens for face width (broad face width), wide nasal bones are commonly perceived among Asian patients (Suhk et al. 2015). To achieve an aesthetically pleasant nasal root width (i.e., two-thirds of the alar base width or two-thirds of the intercanthal distance), medial and lateral nasal osteotomies could be applied (Suhk et al. 2015).

When appraising the profile view, the height of the nose (soft tissue nasion to subnasale points) of Asians appears much different from other ethnic groups, but the nasal height is almost identical (Farkas et al. 2005).

Overall, the distance from the soft tissue nasion point to pronasale point (nasal bridge length) is equal to the distance from the stomion point to the soft tissue menton point (lower facial dimension) (Suhk et al. 2015). The nasal bridge length (soft tissue nasion to pronasale points) is usually measuring between 45 and 50 mm in Asian norm, which is shorter than the Caucasian norm (Suhk et al. 2015; Farkas et al. 2005). To lengthen the nasal bridge dimension (soft tissue nasion to pronasale points), dorsal augmentation or tip-derotation technique could be used (Suhk et al. 2015).

22.6.2 Nasal Tip

Unlike Caucasian noses, the tip of Asian nose is low, wide, and rounded (Park et al. 2015; Suhk et al. 2015; Li et al. 2014; Han et al. 2004; Letourneau and Daniel 1988; Zingaro and Falces 1987; Kim and Jeong 2019, 2020).

Compared with Caucasian individuals, the nasal tip (nasal tip protrusion: subnasale to pronasale points) of Asian individuals is more retruded and poorly defined because of the weak support of the columellar framework and abundant subcutaneous soft tissue combined with thick skin; moreover, the septal cartilage of some Asian individuals is thin and small (Suhk et al. 2015). Overall, nasal skin thickness is an important predictive factor for nasal tip surgery success. Strut graft, septal extension graft, tip graft, and tip sutures can be adopted to enhance the nasal tip protrusion.

The nasal tip angle is formed by the lines following the general direction of the columella and the nasal bridge. Nasal tip rotation technique creates the nasal tip angle (nasion to pronasale to subnasale) blunt with a shorter nose, whereas nasal tip derotation technique makes the nasal tip angle acute with an elongated nose (Suhk et al. 2015).

The bulbous and poor definition of supratip breakpoint of Asian noses demands for the approximation of the lower lateral crura, which increases the nasal tip projection and definition and emphasizes the supratip break (Suhk et al. 2015).

Asian noses present with a wide angle of domal divergence, blunting the nasal tip-defining points (created by the dome of the lower lateral cartilage) (Suhk et al. 2015). By using the interdomal suture technique (Ghavami et al. 2008), the angle of domal divergence is reduced, the nasal tip-defining point is narrowed, and nasal projection is increased.

The nasolabial angle (the angle between the vertical facial plane and a line connecting the anterior and posterior ends of the nostril) is usually 95–100° in females, and 90–95° in males (Suhk et al. 2015). Asian noses could have a considerable upward tilt of the nasal tip combined with an increased nostril exposure (Suhk et al. 2015; Denadai et al. 2021a). Culturally, this upward nasal rotation with nostril exposure is connected with poor appearance because such a nasal feature is believed to produce financial misfortunes in Asian society (Denadai et al. 2021a). This nasal feature is deprecatingly called the "piggy" nose deformity, emphasizing the cultural and psychosocial impact of nasal appearance among Asian individuals (Denadai et al. 2021a). Surgeons should then individualize the nasolabial angle according to the patient's beliefs and desires.

As the Asian nose has a wider alar width (alare to alare points; alar curvature to alar curvature) in relation to the nasal height, alar reduction surgery is commonly performed in Asian rhinoplasty (Watanabe 1994; Aung et al. 2000; Suhk et al. 2015).

22.7 Postoperative Care

Nasal packing and dorsal nasal splinting are left for 72 h and 4 weeks postoperatively, respectively. The midcolumellar sutures are removed 1 week after surgery. If an internal paraseptal splint is used, it is maintained for 1 month postoperatively. Oral antibiotics and pain medication are prescribed for 5–7 days. The patient is advised to avoid intense physical activities for 1 month after the nasal surgery.

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