Classifying Deformities of the Columella Base in Rhinoplasty

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Background: Although much has been published with regard to the columella assessed on the frontal and lateral views, a paucity of literature exists regarding the basal view of the columella. The objective of this study was to evaluate the spectrum of columella deformities and devise a working classification system based on underlying anatomy.
Methods: A retrospective study was performed of 100 consecutive patients who presented for primary rhinoplasty. The preoperative basal view photographs for each patient were reviewed to determine whether they possessed ideal columellar aesthetics. Patients who had deformity of their columella were further scrutinized to determine the most likely underlying cause of the subsequent abnormality.
Results: Of the 100 patient photographs assessed, only 16 (16 percent) were found to display ideal norms of the columella. The remaining 84 of 100 patients (84 percent) had some form of aesthetic abnormality and were further classified based on the most likely underlying cause. Type 1 deformities (caudal septum and/or spine) constituted 18 percent (18 of 100); type 2 (medial crura), 12 percent (12 of 100); type 3 (soft tissue), 6 percent (six of 100); and type 4 (combination), 48 percent (48 of 100).
Conclusions: Deformities may be classified according to the underlying cause, with combined deformity being the most common. Use of the herein discussed classification scheme will allow surgeons to approach this region in a comprehensive manner. Furthermore, use of such a system allows for a more standardized approach for surgical treatment. (*Plast. Reconstr. Surg.* 133: 464e, 2014.)

Fundamental to the evolution of rhinoplasty is greater focus on the columella and its contribution to the overall aesthetic outcome. Although much has been published with regard to the columella assessed on the frontal and lateral views, a paucity of literature exists regarding the basal view of the columella. Ideal aesthetics include a central columellar width approximately one-third the width measured at the very base of the columella. However, characteristics of the lateral columella contour and shape are the most crucial factors influencing overall nasal aesthetics and harmony. The lateral border of the columella forms what we have termed the "basal aesthetic lines," as they serve to transition the upper lip to the nasal lobule. These basal aesthetic lines act in a manner similar to the dorsal aesthetic lines on the frontal view (Fig. 1). Ideally, the nostril should form a teardrop shape opening with a medially tilted long axis extending from the base to the apex.[1] For the medial nostril to completely satisfy the aesthetic ideal, the lateral columella must be smooth in contour, exhibiting a slight curve (Fig. 2).

Understanding deformities of the columella requires a working knowledge of the underlying anatomy and tissue interplay between structures. The structural integrity of the columella is derived primarily from the caudal septum and medial crura, both seated on the nasal spine. The relationship of these structures has been well described on a gross scale and with histologic analysis to a

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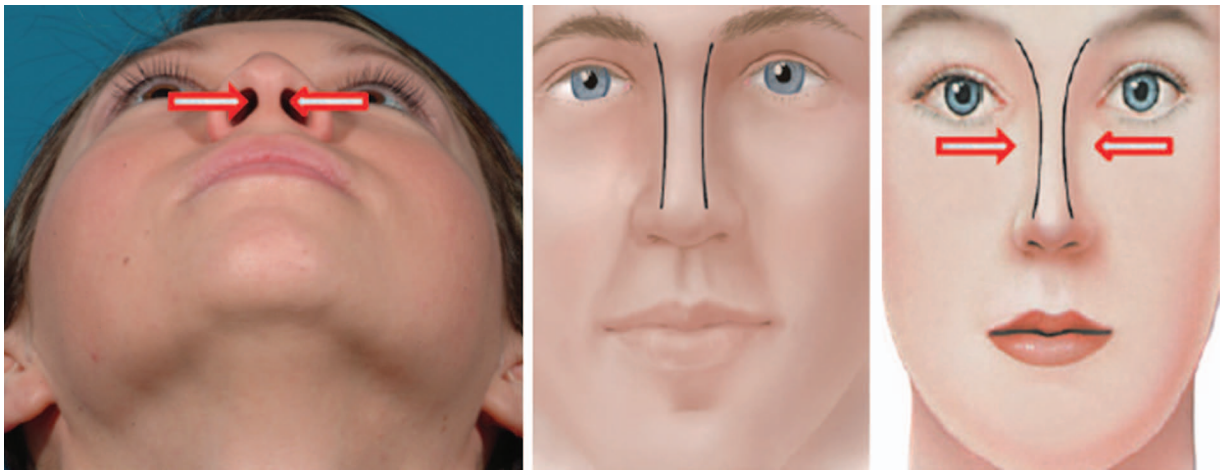

Fig. 1. The basal aesthetic lines are created by the lateral border of the columella and contribute to overall nasal harmony, similar to dorsal aesthetic lines on frontal view.

lesser degree.[2–5] Aberrations of the nasal spine, septum, or medial crura lead to distortion of the columella and should be corrected during rhinoplasty.[6] Furthermore, soft-tissue abnormalities of the columella may compromise aesthetic ideals either alone or in conjunction with cartilage malposition. These soft-tissue anomalies manifest as either overabundant or insufficient volume, thus altering the desired smooth concave transition from the nostril sill to nostril apex.

The functional implications of columellar abnormalities are often overlooked and should be assessed during rhinoplasty.[6] The cross-sectional area of the nostril is intimately related to external valve functionality. Clinical obstruction may result from anatomical restriction of nostril airflow, thus emphasizing the importance of both identifying and treating columella deformities. Alterations in position of the lateral and intermediate crura may influence the medial crura, warranting constant assessment to ensure that a secondary deformity is not created.

The objective of this study was to evaluate the spectrum of columella deformities and devise a working classification system. Such a system should be based on the relevant underlying anatomical structures responsible for the deformity. Providing an organized approach at diagnosis allows for a more standardized process of treatment.

PATIENTS AND METHODS

A retrospective study was performed of 100 consecutive patients who presented for primary rhinoplasty. The preoperative basal view photographs for each patient were reviewed (M.R.L. and J.R) to determine whether they possessed ideal columellar aesthetics. The ideal columella was defined as displaying a teardrop shape, with the long axis extending from the base to the apex and with a slight medial tilt toward the midline. The lateral columella border was required to form a smooth, concave slope bridging the upper lip to the nasal lobule.

Patients who had deformity of their columella were further scrutinized to determine the most likely underlying cause. Causes were characterized as (1) caudal septum or nasal spine; (2) medial crura; (3) soft tissue; or (4) combination of septum or spine, medial crura, and/or soft tissue. Patients found to have abnormal volumes of soft tissue were further determined to have excess or insufficient soft tissue. When

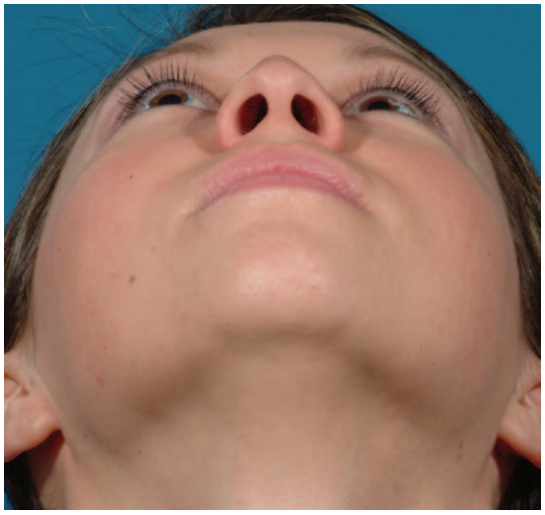

Fig. 2. The basal columella creates the medial border of the nostril and should provide a smooth transition from the nasolabial junction to the nasal lobule.

determining which patient had malpositioned medial crura or footplate flare versus soft-tissue abnormality, the reviewers relied on clinical experience and judgment. The identification of a cartilaginous imprint on the adjacent soft tissue leading to distortion placed patients into the group of medial crura aberration. If this was not present and the deformity appeared completely related to soft tissue, they were classified accordingly. If both were identified as instigating the deformed base, they were allocated to the combination group.

RESULTS

Of the 100 patient photographs assessed, only 16 patients (16 percent) were found to display ideal norms of the columella. These patients exhibited normal nostril ideals, with an appropriate columellar relative width and the aforementioned contour transition (Fig. 2). The remaining 84 of 100 patients (84 percent) had some form of aesthetic abnormality and were further classified based on the most likely underlying cause. Patient composition included Caucasians (78 of 100), Hispanics (13 of 100), African Americans (five of 100), and Asians (four of 100). Eighty-four patients were female patients and 16 were male. There appeared to be no relationship between ethnicity or sex and deformity of the columella.

Type I Deformity

Eighteen of the 100 patients (18 percent) were noted to have columella distortion related to either the caudal septum or nasal spine (Fig. 3). Patients in this group were identified as having only involvement of their caudal septum or nasal spine with normal soft-tissue volume and correct positioning of the medial crura. Those patients with deviation of the caudal septum or spine and concomitant distortion of adjacent structures were not included in this group. Both the spine and septum were classified together, as determining whether the spine is altered from the midline requires direct intraoperative visualization. Nasal spine malposition is much less frequent and, by definition, associated with malposition of a seated caudal septum.

Type II Deformity

Twelve of the 100 patients (12 percent) were identified as having medial crura abnormality as the primary cause. The most commonly identified medial crura irregularity was premature flaring with nostril contour compromise and impingement of the nasal airway. Premature flaring occurred both in symmetric and asymmetric fashion and to varying degrees of severity (Fig. 4). Lack of footplate flare was noted in three of 12 of these patients (25 percent), which resulted in an overly long and slender columella. Although the slender columella leads to a more patent airway, it deviates from the aesthetic norm of the medial nostril and disrupts the overall transition of the face to the lobule. Other notable abnormalities included buckling from excessive medial crura volume, which was most often asymmetric.

Fig. 3. Type I deformity. Caudal septum aberrancy is primarily responsible for the columella distortion. Malposition of the nasal spine is also classified as a type I deformity. (*Right*, Printed with permission from Alfredo Portales. Copyright ©Burning Heart Studios.)

Type III Deformity

Type III deformities consisted of those patients with abnormal soft-tissue volume and were diagnosed in six of 100 patients (6 percent). This subset of patients had deformity of the basal columella but appeared to have normal position of the nasal spine, caudal septum, and medial crura. The instigating factor alone was a soft-tissue volume anomaly or malposition. Patients with a columella suffering from volume excess were further classified as type IIIA (four of six), whereas those with insufficient volume were classified as type IIIB (two of six). Patients classified as type IIIA were noted to have excess volume with normal positioning of the medial crura (Fig. 5, *above*). Patients with type IIIB deformities also appeared to have normally positioned medial crura but insufficient tissue volume to maintain the ideal columellar shaft–to-base ratio (Fig. 5, *below*). The purpose of further division among this group is directly related to the variation of corrective treatments.

Type IV Deformity

Patients were classified as having a type IV deformity when any combination of spine, caudal septum, medial crura, and/or soft-tissue aberration was noted (Fig. 6). This group was the largest, comprising 48 of 100 patients (48 percent). Although the histology of the nasal base has been poorly studied, gross dissections have revealed the intimate relationship among such structures as the nasal septum, nasal spine, medial crura, and adjacent soft tissue. Such relationships create tissue interplay whereby distortion or deviation of one structure often leads to that of another. This appeared to be evident, as those patients with severe deflection of the caudal septum also exhibited an associated malposition of the medial crura. The majority of type IV cases included deformities of the caudal septum and medial crura, with a much smaller portion of cases noted to have some influence from soft-tissue abnormality. Furthermore, a subset of patients exhibited midline soft-tissue excess with abnormal outward displacement of the medial crura, whereas the caudal septum appeared to be in normal midline position.

DISCUSSION

Although often eclipsed in rhinoplasty discussion, the basal view of the columella serves as an important anatomical structure, contributing to overall nasal aesthetics and harmony. The columella serves as the midline transition from the lip to the nasal lobule, with deformities generating incongruence. These deformities may be the result of embryologic development, nasal trauma, or even iatrogenic injury from prior nasal surgery.

It has been suggested that abnormal septal development leads to asymmetric development of the adjacent lower lateral cartilages, thus creating an even more complex dilemma for the rhinoplasty surgeon.[6] Although relevant, cause is less important than the actual presiding anatomical deformity. The gross anatomy of the columella is well established and known to consist of the soft tissue, medial crura, and caudal septum. The nasal spine serves as the buttress to the cartilaginous framework, thus significantly influencing lower nose position. When attempting to classify abnormalities of the basal columella, consideration of

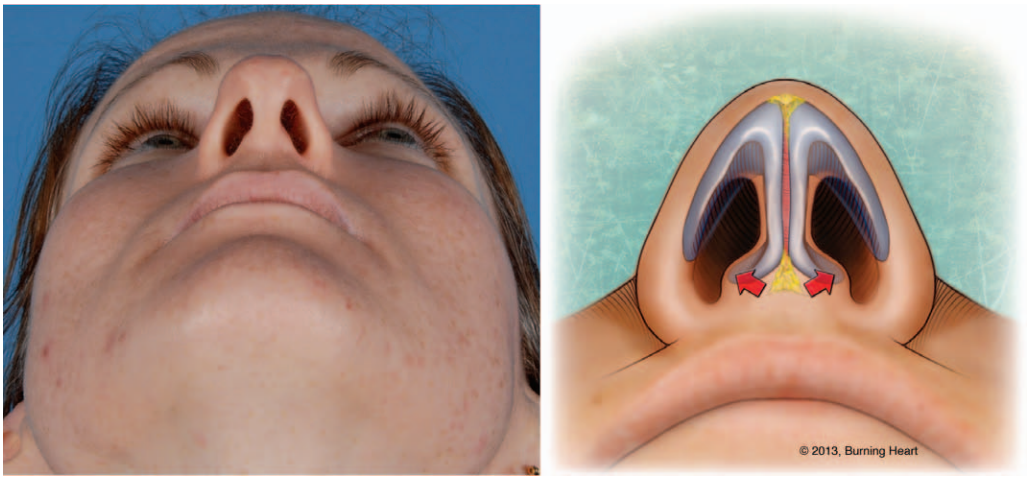

Fig. 4. Type II deformity. Abnormal medial crura are primarily responsible for columellar distortion. Premature flaring of the medial crura footplates represents the most common cause of a type II deformity. (*Right*, Printed with permission from Alfredo Portales. Copyright ©Burning Heart Studios.)

Fig. 5. (*Above*) Type IIIA deformity. Soft-tissue excess is primarily responsible for columellar distortion and may obstruct nasal inflow. (*Below*) Type IIIB deformity. Soft-tissue deficiency is primarily responsible for abnormal columella. (*Right*, Printed with permission from Alfredo Portales. Copyright ©Burning Heart Studios.)

all of these structures is crucial. Invaluable discussion resides in the literature regarding abnormalities of the nasal spine, septum, and medial crura.[6–9] In contrast, soft-tissue deformity has been largely ignored. Ideally, the caudal septum should be midline and flanked by the medial crura. The medial crura should continue in a linear pattern, with lateral flaring at the distal portion allowing the framework for the concave columella. These structures are separated by a thin layer of soft tissue and together deliver the internal integrity for the external columellar appearance. Interspersed to varying degrees in the columella are soft tissues consisting of skin, adipose tissue, and collagen fibers. Abnormalities of the cartilaginous or soft tissue can lead to deviation from aesthetic ideals and serve as the premise for the aforementioned classification system.

Preoperative analysis and diagnosis, although not always conclusive, is a fundamental component of successful rhinoplasty. Use of this classification system provides the framework for a comprehensive assessment of the basal columella. Although surgical techniques to address the columella base are not overabundant, they do exist.[10,11] The goal of this article is to provide a thorough system by which aberrations may be better understood.

Although delving into specifics related to correction of each deformity is beyond the scope of this article, illuminating the relationship between grouping and general surgical approach is prudent. Type I deformities will require direct surgical visualization to assess the nasal spine and caudal septum. If the spine is malpositioned, efforts must be made to relocate it.[6] Following relocation of the spine, the caudal septum often requires surgical manipulation or repositioning. More frequently, the spine is midline and the caudal septum is the instigating factor. Efforts are focused on straightening the septum with

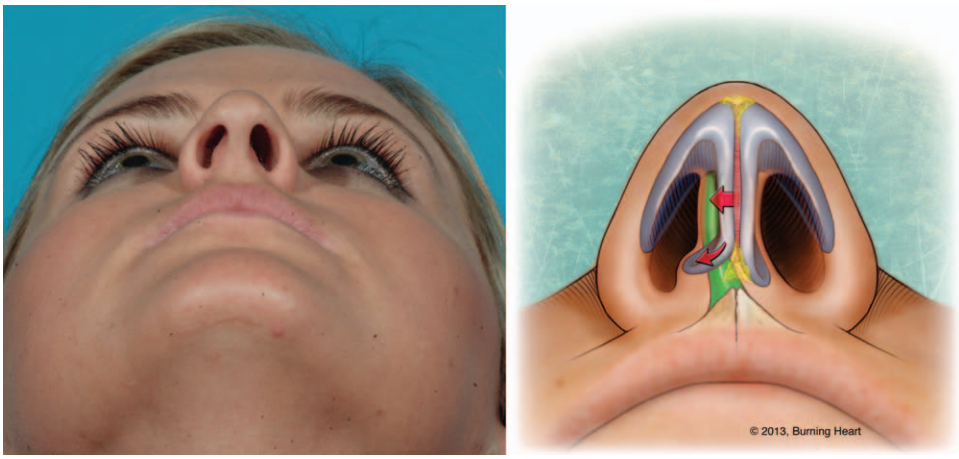

Fig. 6. Type IV deformity. A combination of septum, medial crura, and/or soft tissue is responsible for columellar distortion. (*Right*, Printed with permission from Alfredo Portales. Copyright ©Burning Heart Studios.)

cartilage weakening or resection, suture techniques, or struts. Type II deformities related to abnormal location or volume of medial crura require a focused effort on establishing adequate framework symmetry and support. The most common cause in this study was premature flaring of the footplates, which may also have a functional corollary. Abnormal flare may be corrected with suture techniques, whereas weak medial crura may need reinforcement with cartilage grafting such as a columella strut. Normal flare of the medial crura should be preserved to allow for the ideal lateral columella contour. Methods of improving footplate flare when absent have been much less discussed in the literature. Also receiving modest attention is the correction of type IIIB deformities. These patients need additional volume to create the ideal nostril and, although cartilage grafting will add volume, injecting fat for such deformities may be more prudent. The use of cartilage grafts in this area is nonanatomical, whereas use of fat injection may be more appropriate. Type IIIA deformities have been discussed, with authors varying on resection or compression of soft tissue.[1,10,11] Type IV deformities often demand the most aggressive approach to correction because of the complexity of tissue interplay among the involved structures. If the primary dilemma is septal deviation, correction of the septum may allow for return of normal medial crura into position. However, if both structures are innately aberrant or injured, they must be addressed separately. This may be particularly relevant to cases of embryologic development or prior trauma.[6] Furthermore, if after correction of the underlying cartilage there is abnormal soft-tissue volume or distribution, this will require correction to create the ideal columella base.

Functional implications of a deviated nasal base should not be overlooked.[6] Cartilage or soft-tissue deflection into the nostril can significantly restrict nasal inflow. Although many techniques have been described to address the internal valve, nostril inflow and the external valve patency play crucial roles in overall resistance. Patients with weakened medial crura often display similar lateral crural weakness, predisposing them to external valve collapse.[5,6] If such problems are not diagnosed and addressed, patients may develop postoperative obstruction regardless of the most aggressive middle vault surgery. Moreover, obstruction of the nostril from tissue deflections may compromise airflow, leading to functional deficit. Often conceptualized as three independent crura, it is important to remember that the alar cartilages function as a unit. Manipulation of the lateral and/or middle crus will influence position and volume of the medial crus. Such techniques to alter projection through crura steal or correction of the infratip lobule hinge on this principle.[12] Subsequently, it is wise to repeatedly evaluate the medial crura following alterations to any portion of the alar cartilage. Failure to identify an iatrogenic deformity will compromise the result and should be avoided.

CONCLUSIONS

Successful rhinoplasty requires diagnosis and treatment of the columella base. Deformities may be classified according to the underlying cause, with combined deformity being the most common. Use of the herein discussed classification

scheme will allow surgeons to approach this region in a comprehensive manner. Furthermore, use of such a system allows for a more standardized approach for surgical treatment.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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