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Columellar reconstruction in children

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Defects of the nasal complex can cause significant functional and psychosocial impairment. Nasal reconstruction aims to restore the normal trilaminar structure of the nose, which includes the internal lining, cartilaginous framework, and soft tissue envelope. Among the nasal subunits, the columella is especially challenging to reconstruct due to its unique contour and composite nature. Multiple techniques have been described, each carrying distinct advantages and disadvantages; however, the optimal procedure for an isolated defect of the columella remains elusive. The ideal reconstructive technique should recreate the contour of the columella, provide nasal tip projection, and maintain external valve patency. Additional considerations include matching the pigmentation and texture of the nasal skin while minimizing donor site morbidity. The authors recommend a 2-stage reconstruction with bilateral nasal sill flaps and an auricular composite graft.

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Introduction

The focal point of the face is the nose, a well-defined, and highly contoured pyramidal structure centrally positioned between the eyes and mouth. Functionally, the nose facilitates the warming, humidifying, and filtering of inhaled air as the main respiratory passageway. Defects and distortions of the nasal anatomy disrupt the esthetic harmony of the face, and potentially limit the functional capacity of the nose, resulting in psychosocial impairment, and respiratory compromise respectively. The goals of nasal reconstruction are to restore the normal trilaminar structure of the nose, including the internal mucosal lining, the supporting cartilaginous framework, and the external soft tissue envelope, thereby reestablishing a key facial feature and maintaining airway patency. Current strategies for nasal

reconstruction employ adeptly camouflaged incisions, closely matched donor tissues, and 3-dimensional graft or flap patterns in concordance with the affected topographic nasal subunits.¹

Among the nasal subunits, the columella is arguably the most challenging to reconstruct due to its subtle contour, location, and composite configuration. The columella consists of 3 proportionate segments: the anterior lobular portion, the narrow intermediate portion, and the flared basal portion. The columellar break point topographically marks the transition between the nasal tip and the lobular columella at the junction between the intermediate and medial crura of the alar cartilages. In addition, the intermediate segment, supported by the medial crura and the caudal septum, produces the columellar show, which defines the columella's relationship to the alar margin on lateral view. Finally, the columellar base follows the curvature of the medial footplates, flaring upon insertion at the lip to form the characteristic pyramidal shape. Together, the columellar segments determine nasal tip projection, columellar-alar relationships, and nasolabial angle definition. Therefore, partial or complete defects of the columella can disrupt these

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critical landmarks and relationships, resulting in severe esthetic deformity.

Although the cosmetic and structural importance of the columella is obvious, the ideal operation for an isolated defect of the columella remains elusive. A wide variety of techniques have been described, but have limited application and unpredictable results. Although skin grafts may be appropriate for superficial abnormalities, more severe defects involving the cartilaginous framework necessitate composite grafts or flap coverage. Composite grafts may provide appropriate structural support, but can be limited by the recipient site vascular supply and high metabolic demand. Furthermore, local and regional flaps can cause unacceptable donor site deformity, and may still require additional support to avoid collapse and contraction. Ultimately, the goals of columellar reconstruction are to recreate the convex contour of the columella, enhance nasal tip projection, and maintain external valve patency, which requires reestablishment of the mucosal lining, cartilage framework, and cutaneous coverage. In addition, the ideal procedure would optimize esthetic results by matching the pigment and texture of the donor tissue to surrounding nasal skin, and minimizing donor site morbidity.

Preoperative evaluation

The preoperative evaluation allows the surgeon to assess the scope of the nasal defect including the subunit(s) and the layers involved, discuss the reconstructive options, and weigh the burden of care on the patient. The surgical plan should address a staged approach is indicated, and donor site selection with its accompanying morbidity. The underlying cause of the defect should be considered when selecting the surgical approach and timeline. Columellar defects may be the result of trauma, infection, malignancy, tumors, and congenital absence. Depending on the mechanism of injury, surgical intervention may be delayed in order to observe for tumor recurrence or allow for resolution of inflammation. The etiologic process may damage neighboring facial subunits, constraining the surgeon to use more distant tissue for reconstruction. Therefore, a global assessment of the properties and qualities of the adjacent, local, and regional tissues is required to determine the optimal donor site. Finally, concerns about esthetic result and recovery time should be appropriately weighed when finalizing the surgical plan, and the patient and his or her family should be counseled in regard to realistic outcomes.

Surgical techniques

Several techniques have been described in the literature for columellar reconstruction, including full thickness skin grafts, local random pattern flaps, regional flaps, and composite grafts. With the exception of superficial defects of the skin and soft tissue, direct primary closure and skin grafts are rarely suitable. Due to the composite nature of the columella, flap coverage with adjunctive cartilage or

composite grafts are required more often. Chondrocutaneous auricular composite grafts are useful for providing cartilaginous support with compatible, non-hair-bearing skin.²⁻⁴ Similar to the columellar skin, the auricular skin from the helical crus is extremely thin, and adheres tightly to the underlying cartilage. In contrast, skin flaps used for columellar repair are thicker than the native nasal skin due to additional subcutaneous fat, which increases the likelihood for a secondary debulking procedure. However, since graft survival depends on a well-vascularized recipient bed, composite graft implementation is generally limited by size.^{2,3} Although Son et al⁵ reported successful use of auricular composite grafts as large as 10 × 19 mm for defects of the columella, they note that scrupulous technique and ideal conditions are required for success.

In contrast, the use of local random pattern flaps decreases the concern for a well-vascularized bed. Numerous local flaps have been described for columellar reconstruction, including upper lip flaps,⁶⁻¹⁰ alar margin flaps,^{6,7,11,12} internal nasal vestibular flaps,¹³⁻¹⁵ labial mucosa flaps,^{16,17} nasal septal flaps,^{18,19} nasal sill flaps,^{3,4,20} nasolabial flaps,²¹⁻²⁵ nasomalar flaps,²⁶⁻²⁸ and Abbe flaps.²⁹ Due to the surgical simplicity and nasal tissue pigmentation match, these techniques have been popularized. Regional flaps, including axially based forehead flap,^{30,31} the Washio flap,³² the submental flap,³³ and tubed flaps,³⁴⁻³⁶ have also been used when there is a paucity of local tissue available for reconstruction or to limit distortion of the normal local anatomy. However, both local and regional flaps may carry possible disadvantages, such as necessitating multiple stages, donor site distortion, and transferring hair-bearing skin. Furthermore, without underlying cartilage support, local flap procedures may be complicated by contraction and resultant loss of nasal tip projection. In contrast, regional flap procedures provide greater tissue bulk. However, they often transfer excess tissue for defects confined to the columella, and are more appropriate for defects involving multiple nasal subunits.

The advent of free tissue transfer has extended the reconstructive ladder. Composite flap procedures, such as the preauricular flap, prefabricated retroauricular flap, and first webspace of the foot flap,³⁷⁻³⁹ are alternatives to traditional procedures, delivering both external coverage and internal support while negating the reliance on a well-vascularized bed that composite grafts demand. The technical aspects of these procedures, which require microsurgical proficiency, may impede widespread adoption.

Overall, the optimal reconstructive procedure varies according to defect cause, the affected components of the columella, and donor site availability. For isolated columellar defects, which involve the underlying cartilage framework without significant scarring or vascular compromise of the surrounding tissues, the authors recommend a 2-stage reconstruction with bilateral nasal sill flaps coupled with an auricular composite graft. The procedure was previously described in a pediatric patient with an ischemic injury of the columella secondary to placement of a temporary nasogastric tube.⁴⁰ The rationale for the procedure stemmed

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