



## Multi-Ethnic Rhinoplasty: Anatomical Features and Surgical Techniques for an Appropriate Nasal Tip Projection

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### Abstract

**Background:** The aim of this study is to evaluate the anatomical features of the nasal tip, which presents specific characteristics in each single ethnic group. The knowledge of these inter-ethnic differences is mandatory to plan the appropriate surgical technique in order to realize a successful rhinoplasty.

**Methods:** A systematic literature review was conducted to select studies estimating the anatomical traits of the nasal tip across three principal ethnic groups: Caucasian, African and Indian. A multiple analysis was led to identify the most common anatomical features that distinguish the nasal tip in every ethnic group. An additional meta-analysis was applied to compare specific surgical maneuvers performed to correct each anatomical defect after an appropriate preoperative planning.

**Results:** The article describes substantial anatomical differences between Caucasian, African and Asian nasal tip projection and proportions. The main nasal tip anomalies vary from patient to patient and from an ethnic group to another. The achievement of a proper nasal tip projection requests a precise knowledge of the nasal tip anatomy and anomalies, according to the assessment of an accurate preoperative plan and to the application of specific rhinoplasty techniques.

**Conclusion:** An accomplished rhinoplasty implicates the acquisition of an appropriate nasal tip projection. A complete comprehension of the inter-ethnic anatomical differences is essential to obtain the ideal nasal tip projection. This study aims to become the use deal for the inter-ethnic nasal tip surgery in everyday practice.

**Keywords:** Rhinoplasty; Nasal tip anatomy; Nasal tip projection; Nasal tip deformities; Ethnic rhinoplasty

### Introduction

This review is intended to be a starting point for reflection on the anatomical differences that each surgeon must consider when planning to perform an ethnic rhinoplasty. Although differences are varied from patient to patient there are some common characteristics related to each single ethnic group. In this paper we wanted to emphasize a possible ethnic pattern with variation in rhinoplasty techniques to achieve a good nasal tip projection. While striving to obtain the correct proportions, preoperative planning should consider the nose as a very important part of the patient's face. Achieving good proportions of the nose in accordance with parameters across the face, which is individual for each patient, is one of the main aesthetic objectives of surgical correction.

### Anatomical Considerations

Nasal tip projection is described as the anteroposterior extent to which the nasal tip is separated from the facial surface. The comprehension of nasal tip anatomy is fundamental to plan a right surgical approach and to achieve a good surgical result [1]. We consider three ethnic groups: Caucasian, African and Asian.

#### Caucasian

The infratip lobule is the nasal region bounded by the tip-defining points superiorly, and the columella caudally. The nostril apices correspond to the midpoint of the infratip lobule [2]. The lower lateral cartilage is divided into medial, middle, and lateral crura [3]. At the junction of the medial

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and middle, the lower lateral cartilage takes a cranial trajectory and turns along its long axis [4,5]. This change in angulation defines the columellar-lobular angle and represents the beginning of the infratip lobule [5]. The Nasomental angle (120 to 132 degrees) is defined by nasion-to-tip line intersecting with tip-to-pogonion line. Upper lip is located 4 mm behind, lower lip 2 mm behind the line from nasal tip-to-menton. The Nasolabial angle (90 to 120 degrees) is determined by columellar point-to-subnasale line intercepting with subnasale-to-labiale superius line. Columellar show (2 mm to 4 mm) defines alar-columellar relationship on profile view [6-8].

### African

Anthropometric studies have identified three types: African, Afro-Caucasian, and Afro-Indian [9]. The upper third of the African nose shows short, thick, and narrow nasal bones that form a more oblique angle to surround a wider opening [10]. The tip is more amorphous due to abundance of soft tissue and to thinner alar cartilages. The nostrils vary from round to flat with a horizontal axis. The Afro-Caucasian nasal bones are longer, thinner, and wider with a more acute angle at their apex to determine a narrower opening. The nostrils have a vertical axis with less flare. The Afro-Indian nose appears long and large. The nostrils change from an oblique to horizontal orientation. The nasal tips of the Afro-Caucasian and Afro-Indian types present a longer columella. These noses are wider due to thick skin and broad alar cartilages [11]. The tip support is weaker with less resistant alar cartilage [12]. The inter-ethnic structural differences are an outcome of climate selection. For cold climates, a long and narrow nasal passage enlarges the intranasal surface area for warming and dampening. For hot climates, a shorter, wider nasal section is sufficient for these same functions [13,14]. The shape, the dimension and the orientation of the paired lower lateral cartilages define the morphology of the nasal tip. The intradomal angle is determined by the transition from the medial to the lateral crus of the lower lateral cartilage. A wide intradomal angle causes a bulbous nasal tip. Wide nostrils present a consistent degree of flare along the alar margin. The alar base width is considered as the distance between the two alar-facial transition points. The premaxilla and the anterior nasal spine are barely prominent. These traits result in an acute nasal labial angle and decreased nasal tip support [15].

### Asian

The essential traits of the Asian nose consist of: Weak tip cartilages; thin, weak septal cartilage; soft tissue in the tip; thick skin; acute columellar-labial angle. The nasal skin is thick, with copious subcutaneous soft tissue. The nasal tip is low, and the lower lateral cartilages are small and weak. The nasal bones are defectively developed, with a resulting low radix. The septal cartilage is thin. The typical Asian nose appears to be small and flat with an insufficient tip definition [16]. The columellar-labial angles of Asians are regularly more acute than those of Caucasians [17].

## Biomechanics and Objective Assessment

The anterior septal angle primarily influences nasal tip projection. The posterior septal angle describes the articulation between the anterior maxillary spine and the quadrilateral cartilage. The stability of this articulation enforces tip support and projection [1]. The crural arch can be synthesized in the nasal tripod concept: The lateral crus represent one lateral limb and the central limb is formed by the paired medial crura. The rotation and projection of the nasal tip can be modified by an alteration of any of these limbs [18]. The M-arch model defines the tip tripod as a continuous arch, formed by the

paired intermediate, medial and lateral crura. Within this model is the lobular arch, including the supratip, infratip and lateral tip lobule, and the domal arch, composed by the intermediate crura and anterior component of the lateral crura [19]. The major nasal tip dynamics support tools comprise (a) size, shape and resistance of lateral and medial crura; (b) fibrous attachment of the alar cartilages to the superior lateral cartilages; (c) fibrous attachment of medial crura to the caudal border of the quadrangular cartilage. The minor nasal tip dynamic support tools involve (a) nasal spine; (b) interdomal ligament; (c) sesamoid complexes of lower lateral cartilages; (d) cartilaginous septal dorsum; (e) membranous septum; (f) attachment of lower lateral cartilages to the soft tissue envelope [1].

Goode's methods of objective assessment involve a vertical line passing between the nasion and alar sulcus. A second perpendicular line is drawn between the alar sulcus and the nasal tip, with a conclusive line joining the nasion to the nasal tip. Goode's index assesses the degree of projection. A normal projection is defined by a ratio of 0.55:0.6 [20]. According to Baum's method, a line goes from nasion to subnasale, and a perpendicular line is extended from this to nasal tip. A normal tip projection is synthesized by a ratio of 2:1 [21].

## Primary Abnormalities

### Caucasian

Excess of infratip lobule projection is due to intrinsic and extrinsic causes. Type I intrinsic abnormalities consist of an excessively long middle cru. Type II intrinsic abnormalities are characterized by an excessively wide or bulky middle crus. A condition of over projection is caused by a wide middle cru pressing the infratip lobule. Type III abnormalities involve malposition or asymmetry of the lower lateral cartilage. Type IV intrinsic abnormalities consist of a combination of types I to III. Type V abnormalities are extrinsic to the lower crus. The infratip lobule can be prominent because of a protruding caudal septum, with possible ptosis of the nasal tip. An excess of infratip lobule projection is frequently caused by alterations of the columellar labial angle and septal deformities [5].

### African

The fundamental abnormalities of the African nasal tip involve: (a) Large tip; (b) Under rotated tip; (c) Lateral crura flare; (d) Increased interalar width; (e) Short columella; (f) Acute columellar-labial angle [22]. An inadequate nasal tip definition is the consequence of thick soft tissue and weak lower lateral cartilages. Nasal tip projection decreases in the horizontally oriented nostrils [15]. The nasal labial angle (91 degrees in women and 84 degrees in men) is more acute, due to a less prominent maxilla [23].

### Asian

We can evaluate several anatomical abnormalities: (a) anomalies of the tip projection, rotation, definition and a weak tip support; (b) short infratip lobular segment, inadequate columellar length and short tip projection; (c) over projection, under projection, under rotation, disproportion in the lobule ratios, asymmetric or broad tips; (d) under projection of the tip is commonly a consequence of an inadequately developed lower lateral cartilage and of a weak caudal septal support. The short nose anomaly often results from a caudal septal deflection [16].

## Secondary Abnormalities

Iatrogenic overprojection may result from excessive attempts to enhance nasal tip projection. This is frequently caused by borrowing

the lateral crura through a strip technique to increase the central limb of the tripod [24]. A previous rhinoplasty or septoplasty may determine a loss of major tip supports with a consequent cephalic rotation of the posterior septal angle and underprojection [1].

## Preoperative Planning

The assessment and planning of the lower third on the nose involve the analysis of the infratip lobule with tip definition, tip projection, alar position, and the alar-columellar relationship [5]. The ratio of the lobule to the columella should be theoretically 1:2. A lateral crus with a large angle will result in a weak facet, determining an over projected nasal tip. Prominence of the anterior septal angle and caudal septum can establish excess infratip lobule projection. Tensions tips and plunging tips can induce nasal tip overprojection [25].

## Surgical Techniques

### Caucasian

Repositioning the medial crura- according to the tripod model, enhancing the central limb and lifting this point requires changing the position of the medial crura. It is necessary to fixate the medial crura to the projected caudal margin of the quadrilateral cartilage or through a columellar strut. The medial crural septal suture, which links the medial crura to the caudal septum, can raise or lower the medial crura. Suture placement through the antero-caudal septum can intensify projection and rotation; placement through the medial crura anteriorly and the caudal septum next to the nasal spine would realize the opposite result in projection [1]. The columellar strut can be located between the medial crura by creating a pocket [26]. The aging nose and the tension nasal tip are two conditions in which the columellar strut is indicated [27].

**Lengthening the medial crura:** The Goldman technique requests separation of the lateral crus from the medial crus by complete dissection lateral to the dome. The lateral crus are mobilized medially and fixed to the medial crura [24]. A revision of this technique by Simons and Adamson increases the solidity of the tripod thanks to cartilage incision, suture stabilization, incomplete excision and overlapping [28,29]. The lateral crura steal achieves cartilage from the lateral crus and adds it to the medial crus. Kridel first applied this procedure to correct wide and bulbous nasal tips [30,31].

**Modifying the length and shape of the lateral crura:** The lateral crural convexity control suture is a horizontal suture used to decrease the convexity of the lateral crus [1]. The transdomal suture, determined by McCollough and English and modified by Tardy and Cheng, requires a medial crural stabilization suture, a horizontal suture through the lateral crus and out to the medial crus beneath the new domal structure [32-35]. As a result, the tip is located superiorly and anteriorly and an additional height of 2 mm to 3 mm can be achieved in case of underprojection [1]. The lateral crural overlay technique described by Kridel and Konior is utilized to reduce the lateral crus [36]. This method consists of a vertical incision in the middle segment of the crus, followed by overlapping of the separated ends to reduce the length of the crus. The intermediate crural overlay technique conceived by Wise in 2006, obtains nasal deprojection [37].

**Modifying the soft tissue envelope:** Onlay grafts with autologous septal or auricular cartilage may be positioned in a subcutaneous pocket above the domes to enhance height and projection. Shield grafts can be fixated to the medial crura in the infratip lobule to

enlarge projection [1].

**Deprojecting the nasal tip without tip rotation:** To achieve a deprojection of the nasal tip without rotation, it is necessary to apply a resection of similar lengths of the lateral and medial crus of the alar cartilage [38,39].

### African

**Tip projection and definition:** The procedures to improve nasal tip projection involve cartilage mobilization with suture fixation techniques, cartilage-grafting techniques and the use of synthetic nasal implants [15]. A marginal and infracartilaginous incision is realized to gain access to the nasal tip structures and deliver the domal cartilages. Mobilizing the lateral crura from the underlying vestibular lining allows the use of cartilage from the lateral crura. Domal sutures can be utilized to improve nasal tip projection. Intradomal sutures are horizontal mattress sutures located through the domal region of the LLCs. These sutures decrease the angle between the medial and lateral crura of the LLCs and narrow the width of the nasal tip. Interdomal sutures attach the posterior medial portion of the domes to one another; this procedure narrows the interdomal distance and improves the nasal tip definition. Cartilage-grafting techniques are often necessary to achieve more stable enhancements. The septum is a frequent choice for autologous cartilage. Conchal or costal cartilage can be harvested and used as grafts. The columellar strut gives support to the nasal tip. A solid columellar strut provides the long-term stability to support other grafts that may be located more anteriorly on the tip. Columellar struts can often be placed lower on the nasal base and adjacent to the anterior nasal spine and premaxilla. The septal extension graft can be attached to the caudal septum in end-to-end, reducing the probability of tip ptosis [40]. Once strut or septal extension graft placement is realized, the nasal tip should be reassessed with additional grafting procedures. Nasal onlay techniques include the placement of cartilage grafts adjacent to the domal segments of the LLC [41]. The soft tissue envelope allows abundant grafts (Figure 1, 2).

**Tip rotation:** Under rotation of the tip can be treated with premaxillary onlay grafts, columella plumping grafts, and suture fixation techniques. The use of costochondral cartilage is indicated to obtain a voluminous graft. Crushed cartilage plumping grafts can be located within the nasal labial angle through a hemitransfixion or transcolumellar incision. This graft adds volume over the anterior nasal spine and premaxilla. If a columellar extension graft is used, the medial crura of the LLCs can be sutured to the caudal end of the graft fixating the nasal tip into the position of desired rotation [15]. Alar Base Modification- The use of cartilage grafts placed adjacent to the



Figure 1: Patient 1 pre- and post-operative.



Figure 2: Patient 2 pre- and post-operative.



Figure 3: Patient 3 pre- and post-operative.

rim or as lateral crural struts decreases alar flare abnormalities. Crural strut grafts can be located along the undersurface of the lateral crura to flatten tip contour. Alar base excision and suture techniques can be applied to the base, the nostril sill, or a combination of both [42].

### Asian

**Cartilage Graft Technique-** This technique is used to improve tip projection, rotation, and definition. It is also effective to enhance tip support [43]. As graft material, it is possible to utilize septal cartilage, conchal cartilage or costal cartilage (Figure 3).

**Shield graft (Infratip Lobular Graft):** This graft is placed above the middle and medial crus of the lower lateral cartilages. This technique lengthens the infratip lobular segment and enhances tip projection [16]. **9.3.2. Modified vertical dome division technique:** Vertical Dome Division (VDD) is used to refine nasal tip contour. VDD can be performed for overprojection or underprojection, suboptimal rotation, disproportionate lobule ratios, and broad or asymmetric tips. The incisions on the domes are placed to borrow a large amount of cartilage from the caudal margin, with a resulting triangular projection of the medialized cartilage in the antero-caudal direction [44].

**Onlay tip graft:** Onlay tip grafting places one or several layers of graft horizontally at the dome of the tip. It can increase tip projection or conceal a tip deformity.

**Septal Extension Graft:** Septal cartilage can be used as a septal extension graft to project the anterior septal angle and to strengthen the support structure [40]. It can adjust short nose anomaly. A caudal extension of the graft can improve columellar retraction [16].

## Conclusion

Tip Projection is always a challenge in rhinoplasty, especially in non-Caucasian noses. Ethnic rhinoplasty assumes knowledge of different clinical features and anatomy, in order to customize any rhinoplasty to the patient, to get the most natural result.

This guideline should explain how to obtain a good tip projection in ethnic patients picking up the right technique.

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