

## Evaluating Nasal Aesthetical Outcomes of Closed Rhinoplasty in Primary Cleft Lip Repair

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### ABSTRACT

Cleft lip and cleft palate are among the most common congenital facial abnormalities affecting the orofacial region, with an incidence of 1 in 600/800 live births. In Indonesia, the incidence of cleft lip and palate is about 1 in every 1000 births. Cleft lip and cleft palate could occur isolated or together in various combinations and often lead to nasal asymmetry. The management of such deformities often requires a multidisciplinary approach, requiring numerous interventions, which include primary rhinoplasty. There are multiple types of rhinoplasties including open-type, semi-open type, and closed-type rhinoplasty. This article aims to review the nasal aesthetical outcomes of patients who have undergone closed rhinoplasty in primary cleft lip and palate repair. By analyzing various articles, we seek to determine the efficacy of closed rhinoplasty in primary cleft lip repair on the nasal aesthetics of the patients when compared to other procedures. Among the types of rhinoplasty, closed rhinoplasty is still a viable option. Although there was no significant difference between the cosmetic results of open-type rhinoplasties when compared to closed rhinoplasties, patients may prefer closed rhinoplasty as it is minimally invasive and provides less scarring. Overall, further research is required to determine the gold standard practice and ensure the optimal strategical approach to achieve the best outcomes.

**Keywords:** nasal aesthetics; closed rhinoplasty; primary cleft lip repair; cleft lip and palate.

### INTRODUCTION

Cleft lip and cleft palate are among the most common congenital facial abnormalities affecting the orofacial region, with an incidence of 1 in 600/800 live births. Cleft lip and cleft palate could occur isolated or together in various combinations or with other facial deformities [1]. Unilateral cleft lip and palate often lead to nasal asymmetry. The cleft nasal deformity associated with unilateral cleft lip is well characterized and is usually deviated towards the noncleft side, which produces a considerable degree of facial disfigurement [2]. People with facial disfigurements are often discriminated against, they are perceived as less attractive and are stigmatized as having unfavorable personality traits. This results in a decline in mental health among cleft lip and palate patients and an inflection in the suicide rate of adults with facial disfigurements, especially clefts [3].

The management of such deformities often requires a multidisciplinary approach, requiring numerous interventions. Primary cleft lip repair is typically done within the first 3-12 months of life and is usually done with primary tip rhinoplasty. It allows the cleft team to proceed with other procedures and therapies along the line and aims to not only repair the lip but also to repair the nasal deformities related to the cleft [2]. There are multiple types of rhinoplasties including open-type, semi-open-type, and closed-type rhinoplasty.

Closed rhinoplasty, or endonasal rhinoplasty, is more typically performed. Open-type rhinoplasty utilizes external cuts and produces scars on the base of the nose, while the incisions of closed rhinoplasty are mostly done inside the nostrils. Although it is inconclusive if closed rhinoplasty leads to better results, it is recommended as it is minimally invasive and produces less scarring [4].

This article aims to review the nasal aesthetical outcomes of patients who have undergone closed rhinoplasty in primary cleft lip and palate repair. By analyzing various articles, we seek to determine the efficacy of closed rhinoplasty in primary cleft lip repair on the nasal aesthetics of the patients when compared to other procedures. Understanding these outcomes is important to optimize treatment strategies and give patients the resources to understand the expected results of the procedures they will choose.

## REVIEW CONTENT

### 1. Cleft Lip and Palate

#### 1.1 Definition of cleft lip and palate

A cleft lip and palate is defined as a congenital abnormality in the development of the upper lip and the roof of the mouth, which creates an abnormal connection between the nostrils and the mouth. These conditions arise when the tissues that form the lip and palate do not fuse properly during fetal development. As a result, a child may be born with either a cleft lip, a cleft palate, or both. The severity and type of cleft can vary, with possible implications for feeding, speech, and ear health as the child grows [5].

#### 1.2 Embryology

##### (a) Development of cleft lip

During the first two weeks of development, the human embryo resembles a flat circular disc. By the third week, its shape changes to a pear-like form as the cranial area expands and the neural tube elongates. In this third week of gestation, neural crest cells—though derived from the ectoderm—play a crucial role in forming the mesenchyme of the head and neck. These cells proliferate and migrate into the frontonasal and visceral arch regions, leading to the development of five primary facial structures or primordia.

In the early part of week 4, the five facial primordia begin to form around the stomodeum (the basic mouth). These include the frontonasal prominence, which arises from the mesenchyme located ventral to the forebrain, as well as the paired maxillary and mandibular prominences that originate from the mesenchyme of the first branchial arch. The frontonasal proliferation contributes to the development of the forehead, nose, and upper part of the primordial mouth. The maxillary prominences will shape the lateral sides of the stomodeum, while the mandibular prominences will define its caudal borders. By the end of week 4, the embryo takes on a horseshoe-shaped cylindrical appearance.

By the end of week 4, the nasal placodes begin to form from the ectoderm surrounding the primitive mouth at the lower part of the frontonasal prominence. Mesenchymal tissues proliferate around the edges of these ectodermal thickenings, resulting in the formation of the medial and lateral nasal prominences. As the placodes sink and deepen, they create nasal pits, which are precursors to the nose and its associated structures.

The philtrum, or the central part of the upper lip, develops from the growth of the medial nasal prominences and the area above the primitive mouth.

Between the end of the sixth week and the beginning of the seventh week, the medial nasal prominences merge with each other, while the lateral nasal prominences contribute to forming the sides of the nose and cheek regions, driven by the rapid proliferation of the maxillary prominences.

By the eighth week, each maxillary process extends forward and connects with the lower edges of the lateral nasal projections, creating a continuous ridge above the mouth that forms the upper lip. These processes continue below the nasal pits to meet at the groove of the upper lip. Mesodermal tissue migrates from the first branchial arch into this growing lip, pushing the fused tissues back together. Typically, the two masses formed by the maxillary prominence will occupy lateral positions, while this mesodermal tissue will take a medial position.

If this fusion process is delayed or if one mass is absent, a cleft lip may occur. A unilateral cleft lip arises when the maxillary prominence on one side fails to merge with the nasal prominence. A bilateral cleft lip occurs when this failure happens on both sides, resulting in two grooves [6].

##### (b) Development of cleft palate

The formation of the palate begins in the fifth week of gestation and is not fully completed until the twelfth week. The period from weeks 6 to 9 is particularly critical. During this phase, a wedge-shaped mass of mesenchymal tissue forms as the maxillary prominences fuse with the medial nasal prominences beneath the nasal pits. As this tissue expands, it separates the future nostrils from the upper lip, resulting in the primary palate.

The secondary palate develops from the paired lateral palatine processes. The medial aspects of the maxillary prominences evolve into shelf-like mesodermal projections that are oriented vertically on either side of the growing tongue. In the seventh week of gestation, as the lower jaw develops, the tongue becomes relatively smaller and moves downward, allowing the palatine processes to grow closer together and rotate into a horizontal position. The medial edges of these shelves undergo apoptosis, which thins the epithelium and facilitates the fusion of tissue from both sides along the midline in an anterior-to-posterior sequence once the shelves are elevated to their proper position.

By the ninth week, the palatal shelves begin to converge posteriorly with the free edges of the nasal septum. By twelve weeks, this fusion is complete, extending from the palatine and maxillary bones to form the hard palate. The soft palate and uvula develop from the posterior region that remains unossified. If this fusion process fails, a cleft palate can occur [6].

### 1.3 Incidence

The prevalence of cleft lip and palate is highest among Asian populations, with a greater occurrence in men than in women [7]. Overall, the incidence of these conditions is estimated to be between 1 in 600/800 live births, or approximately 1.42 per 1000 births [1]. The Asian population shows the highest rates, ranging from 0.82 to 4.04 per 1000 live births, while Caucasians (both American and European) have an intermediate incidence of 0.9 to 2.69 per 1000 live births. The African population has the lowest incidence, with rates between 0.18 and 1.67 per 1000 live births [8]. In Indonesia, the incidence of cleft lip and palate is about 1 in every 1000 births. However, the distribution of types is uneven: cleft lip only accounts for 15%, cleft lip with palate for 45%, and isolated cleft palate for 40% [1]. According to the Indonesia Basic Health Research Report (RISKESDAS), the prevalence of cleft lip and palate in Indonesia rose from 0.08% (80 per 1000 live births) in 2013 to 0.12% (120 per 1000 live births) in 2018 [9].

### 1.4 Etiology

The causes of cleft lip and palate involve a combination of genetic and environmental factors during pregnancy. While the specific reasons for many cases remain unknown [10], these causes can be categorized into two main groups:

**External Factors:** These primarily relate to maternal influences, including:

- Vitamin deficiencies
- Use of drugs by the mother
- Maternal illnesses
- Smoking during pregnancy
- Alcohol consumption by the mother
- Exposure to chemicals [7].

**Hereditary Factors:** These include:

- Cell-cell adhesion issues occur when epithelial cells at the palatal midline fail to disappear, preventing mesenchymal continuity and palatal fusion.
- Cell proliferation problems, affect the formation of neural crests.
- Cell migration issues, impact fundamental cellular processes such as contraction, adhesion, migration, apoptosis, and proliferation.
- Folate and homocysteine metabolism, where adequate folate intake is crucial for cell division and overall homeostasis [11].

### 1.5 Deformities of cleft lip and palate

Cleft lip and palate is a form of orofacial cleft that can be classified according to its laterality, extent, and severity. The classification of laterality includes right, left, unilateral, and asymmetric/symmetric bilateral clefts, with unilateral CL/P being more prevalent than bilateral cases. The extent of the cleft can vary and may result in a cleft alveolus, typically classified as complete, incomplete, or microform.

**Unilateral Cleft Lip:** This condition is marked by a progressive deficiency of tissue and tethering of structures on both sides of the cleft.

On the medial side, the lip appears shortened, with a flattened philtral column and a narrow vermillion [12]. The medial premaxillary segment rotates externally and upward, while the lateral segment rotates internally and laterally. The orbicularis oris muscle fibers attach medially to the base of the columella and laterally to the alar base. This displacement of the nasal septum from the vomerine groove results in a shortened columella. Additionally, the alar cartilage on the cleft side becomes deformed, causing the medial crus to shift posteriorly and the lateral crus to flatten over the cleft.

**Bilateral Cleft Lip and Palate:** In this scenario, the alveolar ridge is divided into three segments: the premaxillary segment is often located outside the mouth, while two lateral/posterior alveolar segments are found intraorally. The lip is also divided into three parts; the lateral lip segments are situated behind the protruding premaxilla and prolabium. The premaxilla and prolabium are completely separated from the lateral lips and maxillary segments, leading to the indentation of the premaxilla by the lateral segment. The size of the prolabium can vary and lacks a normal philtral structure; it also does not contain the orbicularis oris muscle. Nasal deformities associated with complete bilateral CL/P include a short columella, a flattened nasal tip, and alar hooding [13].

### 1.6 Classification

#### (1) Veau Classification

- a) Veau classified clefts of lip into four groups (Figure 2.8)
  - Group 1: Unilateral notching of vermillion,
  - Group 2: Clefts involving vermillion and lip,
  - Group 3: Clefts involving vermillion, lip and nasal floor,
  - Group 4: Bilateral clefting of lip complete or incomplete
- b) Veau classified clefts of the palate into four groups (Figure 2.9)
  - Group 1: cleft of the soft palate
  - Group 2: cleft of hard and soft palate up to the incisive foramen
  - Group 3: clefts of soft and hard palate extending unilaterally through the alveolus
  - Group 4: clefts of the soft and hard palate extending bilaterally through the alveolus

#### (2) International Confederation of Plastic and Reconstructive Surgery Classification

International Confederation of Plastic and Reconstructive Surgery classified the cleft lip and palate into three major groups based on the structure of the defect, location of the defect, and extent of the defect.

- Group 1: Cleft of lip, cleft of palate and cleft of alveolus
- Group 2: Unilateral and bilateral cleft
- Group 3: Complete and incomplete cleft [14].

### (3) LAHSHAL Classification

The LASHAL system, introduced by Kriens in 1985, categorizes cleft lip and palate based on the anatomical structures involved, represented by the letters L (lip), A (alveolus), H (hard palate), S (soft palate), H (hard palate), A (alveolus), and L (lip). Complete clefts are indicated by capital letters, while incomplete clefts are denoted with lowercase letters. For example, 'LAHSHAL' signifies a bilateral complete cleft of the lip, alveolus, hard palate, and soft palate, while a cleft affecting the left side of the lip and alveolus is represented as '...AL'. Additionally, a lowercase letter marked with an asterisk indicates a submucous cleft malformation or microform [15].

## 2. Procedures for treating cleft lip and palate

The treatment of cleft lip and palate typically involves a series of procedures. In Indonesia, the recommended approach for managing these conditions is as follows:

- **Prenatal Care:** During pregnancy, ultrasonography is employed for the early detection of cleft lip and palate in the fetus. A specialist confirms the diagnosis, and parents receive nutritional and psychological consultations from specialists [16].
- **Postnatal Care:** Within the first three months after birth, an orthopedic dental specialist will apply Nasoalveolar Molding (NAM) to correct the curvature of the alveolus and close the gap between the cleft segments. This procedure also helps shape the nasal cartilage and close the gap on the nasal floor. NAM aids in lengthening the columella through non-surgical means and reduces tension on the cleft lip during subsequent surgery, serving as a pre-surgical treatment for cleft lip and palate [17].
- **Surgical Procedures:** For patients aged 6 months to 2 years, preliminary surgical interventions such as cheiloplasty and/or palatoplasty are performed. Alveolar bone grafting is typically conducted for patients aged 10 to 11 years. In Indonesia, common techniques for cheiloplasty include the Fisher method and the Millard method. For palatoplasty, techniques such as von Langenbeck palatoplasty, Veau-Wardill-Kilner (VY pushback), 2-flap palatoplasty, and Furlow double opposing Z-palatoplasty are frequently used [17]. Furthermore, primary rhinoplasty is typically performed alongside cleft lip repair to ensure comprehensive treatment of both structures.

**Ongoing Care:** Throughout their teenage years, patients continue to receive various therapies and consultations to ensure that their bone structure remains stable [16].

## 3. Nasal Anthropometry Profile on Unilateral Cleft Lip and Palate

Common associated features of unilateral cleft nose deformity [2]:

- The nose is elongated on the cleft side.
- The lateral alar is defective and positioned inferiorly and laterally.
- The dome is retrodisplaced.

- The base of the columella deviated away from the cleft.
- The internal web of the nostril is more pronounced and reduces the nostril space on the cleft side anterior nasal spine is Antero laterally displaced.
- Medical crus of the cleft is short buckled away from the cleft reducing the nasal tip height.
- The angle formed between the lateral and medial crura is increased.

## 4. Procedures for Treating Nasal Deformity in Unilateral Cleft Lip and Palate

Primary cleft rhinoplasties can be categorized into open, semi-open, and closed types, each with its techniques and advantages.

- **Open Rhinoplasty:** This type is less commonly performed due to the significant dissection and manipulation of tissues involved. The procedure is conducted under general anesthesia with orotracheal intubation. An inverted-V transcolumellar incision, along with bilateral marginal incisions, is made to expose the lower lateral cartilage and septal cartilage. The cartilaginous septum is then separated from the maxillary crest and secured to the midline with sutures. Excess septal cartilage is harvested, and a strut graft is placed in the columella to enhance tip projection and symmetry. Additionally, a spreader graft is inserted to prevent alar collapse [18].
- **Semi-open Rhinoplasty:** The "semi-open" technique involves making an incision in the mucosa of the nostril to gain access for separating the cartilages of the columella from the alar cartilages. This procedure is similarly performed on the opposite nostril, allowing for debridement at the domus. Once the alar cartilages are fully exposed, various types of rhinoplasty surgeries can be conducted for both functional and aesthetic purposes. This access also enables complete detachment of the nasal septum, allowing for the preferred method to correct any deviations or to remove cartilage as needed [19].
- **Closed Rhinoplasty:** Also known as endonasal rhinoplasty, this technique involves making all surgical incisions inside the nostrils. Sharp scissors are inserted through the columella to free the skin from the medial crus and dome of the alar cartilage, extending to where the lower lateral cartilage attaches to the maxilla [20].

## 5. Outcomes of Closed Rhinoplasty in Primary Cleft Lip and Palate Repair

Closed rhinoplasty in primary cleft lip repair focuses on enhancing nasal aesthetics and addressing associated deformities to restore symmetry and repositioning nasal structures to not hinder further growth. This doesn't eliminate the need for intermediate or secondary rhinoplasty to achieve greater symmetry.

Recent studies have not definitively established whether open or closed rhinoplasty yields better functional or aesthetic outcomes for patients.

However, it was found that an extended incisional approach in open rhinoplasty may provide more reliable and improved results. Notably, reduced columellar sensation was observed only in patients who underwent open rhinoplasty. From a cosmetic perspective, closed rhinoplasty appears to result in less scarring compared to the transcolumellar incision associated with open rhinoplasty [4]. A different systematic review evaluated the long-term outcomes of open versus closed rhinoplasty in patients with unilateral cleft lip. It found no significant advantage of one procedure over the other in achieving nasal symmetry as both methods produced similar results [21]. A separate study found that closed rhinoplasty had less operative time, less amount of bleeding, and less periorbital edema [22]. However, regarding nasal aesthetical results, there was no significant difference between the two procedures.

Another study showed that patients who went through semi-open rhinoplasty had more stable outcomes in the long term when compared to closed rhinoplasty, which allowed patients to avoid secondary nasal corrections in the later stages [23].

### CONCLUSIONS

Among the various interventions related to primary cleft lip and palate repair, primary rhinoplasty is one of the most important procedures done to maintain facial aesthetics. Among the types of rhinoplasty, closed rhinoplasty is still a viable option. Although there was no significant difference between the cosmetic results of open-type rhinoplasties when compared to closed rhinoplasties, patients may prefer closed rhinoplasty as it is minimally invasive and provides less scarring. When looking at long-term statistics, results may differ between types and further research is needed to evaluate the stability of these procedures. Overall, further research is required to determine the gold standard practice and ensure the optimal strategical approach to achieve the best outcomes.

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