

Surgical Management of Cleft Lip and Palate: A Staged Multidisciplinary Approach

Javier Guzmán Villalón^{*1}, Giovanni Alexis Rodríguez Barrón², David Arturo Ruiz Villalba³, Alfredo Hernández López⁴, Mariana Martínez Gómez¹, Monserrat Rendón García¹

¹Hospital General “Dr. Nicolás San Juan”, Toluca, Estado de México, México.

²Hospital Regional de Alta Especialidad de Ciudad Victoria, Ciudad Victoria, Tamaulipas, México.

³Hospital General Regional No. 1, Instituto Mexicano del Seguro Social, Chihuahua, Chihuahua, México.

⁴Centro Médico ISSEMYM “Lic. Arturo Montiel Rojas”, Toluca, Estado de México, México.

ABSTRACT

Cleft lip and palate are congenital craniofacial anomalies that require coordinated surgical, dental, speech, otologic, nutritional, and psychosocial care throughout childhood and adolescence. The objective of treatment is not only anatomical closure, but restoration of lip competence, nasal symmetry, palatal function, normal speech, maxillary arch continuity, dental development, facial growth, and psychosocial well-being. Primary cleft lip repair is usually performed during early infancy, whereas palate repair is performed later, with timing influenced by the need to support speech development while minimizing adverse effects on maxillary growth. Common unilateral cleft lip techniques include Millard rotation-advancement, Tennison-Randall repair, Mohler modifications, Fisher repair, and other anatomical or triangular flap designs. Palatal reconstruction usually involves closure of the oral and nasal layers with functional reconstruction of the levator veli palatini sling through techniques such as intravelar veloplasty, two-flap palatoplasty, von Langenbeck repair, or double-opposing Z-plasty. Secondary procedures remain common and may include fistula repair, speech surgery for velopharyngeal insufficiency, alveolar bone grafting, cleft rhinoplasty, orthodontic treatment, and orthognathic surgery. Although multiple protocols have been described, current evidence does not identify a single universally superior operative sequence. Optimal outcomes depend on individualized surgical planning, standardized follow-up, multidisciplinary coordination, and long-term assessment of speech, facial growth, dental occlusion, airway function, and patient-reported outcomes.

KEYWORDS: cleft lip; cleft palate; cheiloplasty; palatoplasty; intravelar veloplasty; alveolar bone grafting; velopharyngeal insufficiency; cleft rhinoplasty.

ARTICLE DETAILS

Published On:
29 July 2026

Available on:
<https://ijmscrs.com>

INTRODUCTION

Cleft lip and palate are among the most frequent congenital craniofacial conditions and represent a complex reconstructive challenge. Their impact extends beyond the visible facial defect, affecting feeding, speech, hearing, dentition, maxillary growth, nasal form, airway function, and psychosocial development. For this reason, cleft care is best understood as a longitudinal reconstructive pathway rather than a single operation [1,2].

Modern management is multidisciplinary and staged. Surgical repair begins in infancy, but care continues through

speech development, mixed dentition, adolescence, and sometimes adulthood. The main goal is to restore function while producing balanced facial growth and acceptable aesthetic outcomes. However, no universally accepted protocol exists, and timing varies among institutions because different strategies emphasize different priorities, particularly speech development versus facial growth preservation [3–5].

Principles of Management

The surgical plan is determined by cleft anatomy, laterality, cleft width, alveolar involvement, nasal deformity, syndromic status, feeding ability, associated anomalies, and family

Surgical Management of Cleft Lip and Palate: A Staged Multidisciplinary Approach

access to long-term care. Early evaluation should include feeding support, growth monitoring, airway assessment, hearing evaluation, genetic screening when indicated, and counseling by a cleft team. Presurgical orthopedics or nasoalveolar molding may be used in selected infants, particularly those with wide unilateral or bilateral clefts, to improve segment alignment and nasal shape before definitive repair [3,6].

The primary surgical sequence usually begins with cleft lip repair, followed by palate repair. Later stages may include management of middle-ear disease, speech therapy, alveolar bone grafting, secondary lip or nasal revision, and orthognathic surgery. This staged model reflects the fact that cleft deformity changes with growth, and secondary procedures are often part of expected care rather than evidence of failed primary repair [7].

Primary Cleft Lip Repair

Primary cleft lip repair is usually performed during early infancy once the child is medically stable, gaining weight, and safe for anesthesia. The operation aims to reconstruct the orbicularis oris muscle, restore the continuity and height of the upper lip, align Cupid's bow, correct the vermilion, recreate the nasal sill, and improve nasal base symmetry. In unilateral cleft lip, the key technical principle is muscular reconstruction; skin closure alone cannot restore function or symmetry [2,6].

Several techniques are widely used. The Millard rotation-advancement repair remains one of the most influential methods because of its flexibility and ability to place scars along aesthetic subunit borders. Tennison-Randall repair uses a triangular flap to address vertical lip deficiency, while Mohler and modified Millard techniques attempt to improve philtral column reconstruction and nasal base correction. Fisher's anatomical subunit repair emphasizes precise landmarks and restoration of natural lip subunits. Current evidence does not clearly establish one technique as universally superior; choice depends on cleft morphology and surgeon experience [6,8].

Primary nasal correction is commonly performed at the time of lip repair. Conservative repositioning of the alar cartilage, nasal base, and nasal floor can improve early symmetry and may reduce the severity of later cleft nasal deformity. Definitive cleft rhinoplasty, however, is usually delayed until facial growth is near completion.

Bilateral Cleft Lip Repair

Bilateral cleft lip repair presents additional challenges because of prolabial deficiency, premaxillary protrusion, short columella, and bilateral nasal deformity. Surgical goals include central lip reconstruction, orbicularis muscle repair, columellar and nasal base improvement, and preservation of premaxillary vascularity. Wide bilateral clefts may benefit from presurgical orthopedic treatment to improve alignment before repair. Even with careful primary correction, secondary revisions are common because columellar

deficiency, vermilion mismatch, nasal flattening, and lip tightness may become more evident with growth.

Primary Palate Repair

Palate repair is performed to separate the oral and nasal cavities and to create a functional velopharyngeal mechanism for speech. The timing remains debated. Earlier repair may improve speech development by restoring palatal function before the child develops compensatory articulation patterns. Delayed hard palate closure may theoretically reduce maxillary growth restriction, but it may prolong feeding difficulties, nasal regurgitation, and speech-related problems. Systematic review evidence has not shown a consistent overall advantage of one-stage over two-stage palatoplasty across growth, speech, hearing, fistula, or complication outcomes, and certainty remains limited [7].

The essential technical goal of palatoplasty is not only mucosal closure but reconstruction of the levator veli palatini sling. In cleft palate, the levator muscles insert abnormally along the posterior hard palate and cleft margins rather than forming a transverse sling. Intravelar veloplasty reorients these muscles to improve velopharyngeal closure. Common techniques include von Langenbeck repair, Bardach two-flap palatoplasty, straight-line repair with intravelar veloplasty, and Furlow double-opposing Z-plasty. Comparative studies suggest that outcomes depend heavily on patient anatomy and surgical execution rather than technique alone [8].

Single-Stage Versus Staged Repair

Most centers perform staged lip and palate repair, but single-stage primary repair has been described. A single-stage approach may reduce the number of anesthetic events and improve access in settings where repeated operations are difficult. However, concerns include higher fistula rates, speech abnormalities, and increased surgical burden during a single anesthetic in some series. Therefore, single-stage repair may be appropriate in selected settings but has not replaced staged protocols as a universal standard [9].

Secondary Procedures and Long-Term Burden

Even after successful primary repair, secondary surgery is common. Oronasal fistula may cause nasal regurgitation, speech distortion, recurrent inflammation, and family distress. Velopharyngeal insufficiency may require speech therapy, nasoendoscopic evaluation, and procedures such as pharyngeal flap, sphincter pharyngoplasty, palatal lengthening, or revision intravelar veloplasty. Otologic disease is also frequent because eustachian tube dysfunction predisposes children with cleft palate to otitis media with effusion and conductive hearing loss.

The operative burden can be substantial. One tertiary-center audit found that children with cleft lip and palate underwent an average of four operations in early childhood, with ear-related procedures being the most common after primary repair [10]. Long-term studies of bilateral cleft lip and palate also demonstrate high secondary surgery rates, including fistula repair and speech-correcting surgery before or around the time of alveolar bone grafting [11].

Surgical Management of Cleft Lip and Palate: A Staged Multidisciplinary Approach

Alveolar Bone Grafting and Orthognathic Management

Alveolar bone grafting is typically performed during mixed dentition, before eruption of the permanent canine. Its goals are to restore maxillary arch continuity, close residual alveolar fistulae, support tooth eruption, stabilize orthodontic expansion, and improve nasal base support. Iliac crest cancellous bone remains widely used, although alternatives such as recombinant human bone morphogenetic protein-2 have been investigated in selected protocols [12].

As the child grows, orthodontic treatment becomes central to arch coordination and occlusal development. Maxillary hypoplasia may occur due to the cleft deformity itself, surgical scarring, or both. In patients with significant class III malocclusion or midface retrusion, orthognathic surgery, usually Le Fort I maxillary advancement, may be required after skeletal maturity.

Perioperative and Multidisciplinary Considerations

Perioperative care influences surgical outcomes. Feeding optimization, safe anesthesia, pain control, wound protection, standardized postoperative feeding, and early identification of dehiscence or fistula are important. Speech-language pathologists and audiologists should be involved early because speech and hearing outcomes cannot be corrected by surgery alone. Psychosocial support is also important, especially as children enter school age and adolescence [3,13].

Access to timely cleft repair remains unequal. National data have shown disparities in timing of primary cleft lip and

palate repair across racial and ethnic groups, emphasizing the importance of early referral, centralized cleft teams, and systems that reduce delays in care [14].

Discussion

The central challenge in cleft surgery is balancing early functional repair with long-term growth and development. Lip repair seeks early muscular and nasal reconstruction, while palate repair must support speech without producing excessive maxillary growth restriction. Because these goals sometimes compete, different centers have developed different protocols.

Current evidence suggests that no single technique or sequence is superior for all patients. Outcomes are influenced by cleft severity, surgeon skill, perioperative care, speech therapy, orthodontic support, and consistency of follow-up. For this reason, comparative studies often show similar results between protocols, and many conclusions remain limited by retrospective design, small sample size, inconsistent outcome measures, and institutional variability [4,5].

The best results are achieved when surgery is integrated into a long-term cleft pathway. A good primary repair reduces the need for secondary procedures, but it does not eliminate the need for growth-based reassessment. Cleft care should therefore be evaluated not only by early wound healing, but also by speech, hearing, occlusion, facial growth, nasal airway, aesthetic appearance, and patient-reported quality of life.

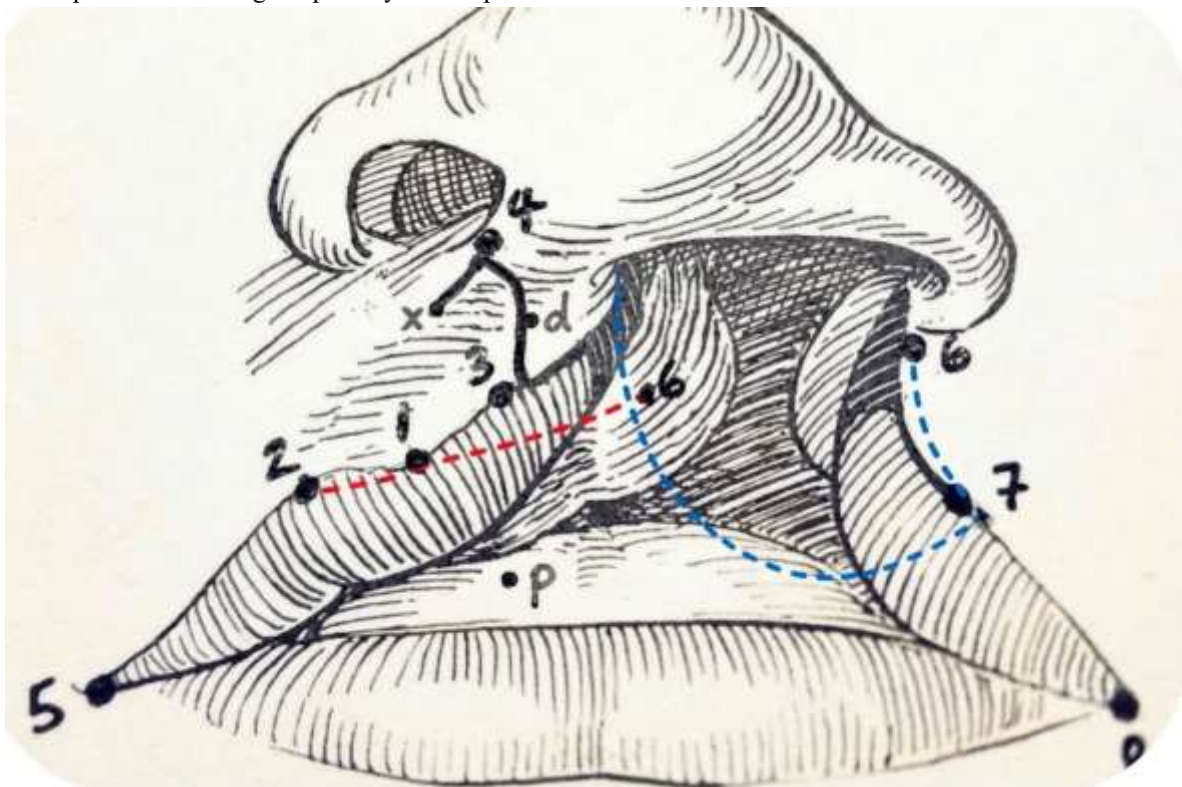


Figure 1. Millard II Unilateral Repair (Markings)



Figure 2. Preoperative and postoperative view for conventional technique

CONCLUSION

Surgical management of cleft lip and palate is staged, multidisciplinary, and individualized. Primary lip repair in infancy restores lip continuity, orbicularis function, and nasal base symmetry. Palate repair later in infancy or early childhood separates the oral and nasal cavities and reconstructs the velopharyngeal mechanism, with timing guided by speech and growth considerations. Multiple lip and

palate techniques are effective, but no universally superior protocol has been established. Secondary procedures for fistula, velopharyngeal insufficiency, alveolar cleft, nasal deformity, dental malocclusion, and maxillary hypoplasia remain common. Long-term success depends on coordinated surgical care, speech therapy, hearing management, orthodontics, psychosocial support, and equitable access to specialized cleft teams.

Stage	Approximate timing	Main intervention	Primary goals
Neonatal evaluation	Birth to first weeks	Feeding support, airway assessment, genetics, team referral	Stabilize infant and plan care
Presurgical preparation	First weeks to months	Nasoalveolar molding or presurgical orthopedics in selected cases	Align segments and improve nasal form
Primary lip repair	Early infancy	Cheiloplasty with muscle reconstruction and nasal base correction	Restore lip continuity, symmetry, and orbicularis function
Primary nasal correction	Often with lip repair	Alar base and lower lateral cartilage repositioning	Improve early nasal symmetry

Surgical Management of Cleft Lip and Palate: A Staged Multidisciplinary Approach

Primary palate repair	Usually later infancy or early childhood	Palatoplasty with intravelar veloplasty when appropriate	Separate oral/nasal cavities and improve speech potential
Otologic care	Infancy onward	Audiology, tympanostomy tubes when indicated	Prevent hearing-related speech delay
Speech surveillance	Early childhood onward	Speech therapy, nasoendoscopy, VPI assessment	Detect and treat speech dysfunction
Secondary speech surgery	Childhood when indicated	Pharyngeal flap, sphincter pharyngoplasty, palatal revision	Correct structural VPI
Alveolar bone grafting	Mixed dentition	Iliac crest bone graft or selected alternatives	Stabilize arch and support tooth eruption
Secondary lip/nasal revision	Childhood to adolescence	Scar, vermilion, nasal, or columellar correction	Improve function and appearance
Orthognathic surgery	After skeletal maturity	Le Fort I advancement or related procedures	Correct maxillary hypoplasia and occlusion
Definitive rhinoplasty	Late adolescence/adulthood	Cleft septorhinoplasty	Final nasal symmetry and airway improvement

REFERENCES

- I. Noorsaeed AS, Alkhudhayri RMA, Alzogibi AM, Almutairi HSS, Barnawi AMB, Tallab RTM, et al. Surgical management of pediatric cleft lip and palate: review article. *Int J Life Sci Pharma Res.* 2022;12:74-87. doi:10.22376/ijpbs/lpr.2022.12.6.SP24.L74-87
- II. Tse R. Unilateral cleft lip: principles and practice of surgical management. *Semin Plast Surg.* 2012;26:145-155. doi:10.1055/s-0033-1333884
- III. Hush S, Williams JK, Brady CM, Soldanska M, Tashima AD. An institution's comprehensive perioperative management of cleft-related surgeries: Part I—cleft lip repair, cleft palate repair, pharyngoplasty, and alveolar bone graft. *FACE.* 2024;6:18-26. doi:10.1177/27325016241302404
- IV. Van Roey VV, Ombashi S, Pleumeekers M, Mathijssen IMJ, Van Der Molen AMB, Munill M, Versnel S. Comparison of two surgical protocols for the treatment of unilateral cleft lip and palate: a multidisciplinary systematic review and meta-analysis. *Int J Oral Maxillofac Surg.* 2024. doi:10.1016/j.ijom.2024.04.003
- V. Naidu P, Plonkowski AT, Yao C, Magee WP. A summary of the existing data on cleft surgical outcomes: what do we not know? *Plast Reconstr Surg Glob Open.* 2025;13. doi:10.1097/GOX.0000000000006660
- VI. Oh TS, Kim Y. A comprehensive review of surgical techniques in unilateral cleft lip repair. *Arch Craniofac Surg.* 2023;24:91-104. doi:10.7181/acfs.2023.00268
- VII. Cornefjord M, Arnebrant K, Guné H, Holst J, Klintö K, Stiernman M, Svensson H, et al. A systematic review of differences in outcome between one- and two-stage palate repair in cleft lip and palate. *J Plast Surg Hand Surg.* 2024;58:132-141. doi:10.2340/jphs.v58.13368
- VIII. Peyvasteh M, Askarpour S, Moradi N, Mansouri A. Comparison of the outcomes of surgical repair of cleft palate performed by modified von Langenbeck and Bardach two-flap palatoplasty methods. *World J Plast Surg.* 2023;12:94-99. doi:10.61186/wjps.12.3.94
- IX. Kantar RS, Rifkin WJ, Cammarata MJ, Maliha S, Diaz-Siso J, Farber S, Flores RL. Single-stage primary cleft lip and palate repair: a review of the literature. *Ann Plast Surg.* 2018;81:619-623. doi:10.1097/SAP.0000000000001543
- X. Fink T, Kilpatrick N, Chong D, Penington T. The early operative burden for children born with cleft lip and palate. *Cleft Palate Craniofac J.* 2024;61:801-807. doi:10.1177/10556656221143301
- XI. Gustafsson C, Heliövaara A, Rautio J, Leikola J. Long-term follow-up of bilateral cleft lip and palate: incidence of speech-correcting surgeries and fistula formation. *Cleft Palate Craniofac J.* 2023;60:1241-1249. doi:10.1177/10556656221102816
- XII. Wadde DK, Chowdhar A, Venkatakrishnan L, Ghodake M, Sachdev D, Chhapane A. Protocols in the management of cleft lip and palate: a systematic review. *J Stomatol Oral Maxillofac Surg.* 2022. doi:10.1016/j.jormas.2022.11.014
- XIII. Raghavan U, Vijayadev V, Rao D, Ullas G. Postoperative management of cleft lip and palate surgery. *Facial Plast Surg.* 2018;34:605-611. doi:10.1055/s-0038-1676381
- XIV. Mullen M, Yan F, Ford ME, Patel K, Pecha PP. Racial and ethnic disparities in primary cleft lip and cleft palate repair. *Cleft Palate Craniofac J.* 2023;60:482-488. doi:10.1177/10556656211069828