BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

SURGICAL TREATMENT OF CONGENITAL CLEFT PALATE IN CHILDREN

Department of Pediatric Dentistry
Karimov Muhammadiso Maxammatjonovich

https://doi.org/10.5281/zenodo.20596801

Abstract Congenital cleft palate is one of the most common craniofacial birth defects, significantly affecting feeding, speech development, hearing, and facial growth in children. Surgical repair remains the cornerstone of management, aiming to achieve anatomical closure, restore velopharyngeal function for normal speech, minimize growth disturbances, and reduce complications such as velopharyngeal insufficiency (VPI). This article reviews the indications, timing, common surgical techniques (including von Langenbeck, Furlow double-opposing Z-plasty, and intravelar veloplasty), perioperative considerations, and outcomes of cleft palate repair in pediatric patients. Early intervention, multidisciplinary care, and individualized approaches are emphasized to optimize long-term functional and aesthetic results.

Keywords: Cleft palate, palatoplasty, congenital craniofacial anomalies, velopharyngeal insufficiency, pediatric surgery, Furlow Z-plasty, intravelar veloplasty

Introduction

Cleft lip and palate represent the most frequent congenital craniofacial malformations, with cleft palate occurring in approximately 1 in 1,000–1,500 live births, varying by ethnicity and geography. Isolated cleft palate or combined cleft lip and palate arises from incomplete fusion of the palatal shelves during embryonic development (typically between the 6th and 9th weeks of gestation). Genetic, environmental (e.g., maternal smoking, teratogens, nutritional deficiencies), and syndromic factors contribute to its etiology.[1] Children born with cleft palate face immediate challenges, including feeding difficulties due to the inability to create adequate negative intraoral pressure, recurrent otitis media with effusion secondary to Eustachian tube dysfunction, and potential speech disorders such as hypernasality and articulation problems if left unrepaired. Long-term issues may include dental anomalies, maxillary hypoplasia, and psychosocial impacts.[2,3]

Surgical treatment is essential to close the palatal defect, reconstruct the levator veli palatini muscle sling for proper velopharyngeal closure, and support normal speech and facial development. Timing of repair is critical: cleft lip repair is often performed at 3–6 months, while palate repair typically occurs between 6–18 months of age. Recent evidence suggests that primary palatoplasty at around 6 months may yield better speech outcomes and lower rates of velopharyngeal insufficiency compared to delayed repair at 12 months, without increasing surgical risks in medically fit infants.[4] A variety of techniques have been developed over centuries, evolving from simple closure to more sophisticated methods that address both hard and soft palate components while minimizing scarring and growth restriction. Multidisciplinary teams—including plastic surgeons, otolaryngologists, orthodontists, speech therapists, and pediatricians—are vital for comprehensive care. This article focuses on the surgical management of congenital cleft palate in children, highlighting current best practices, techniques, and outcomes.[5]

Methodology

This review article synthesizes current evidence on the surgical management of congenital cleft palate in pediatric patients, drawing from peer-reviewed literature, clinical guidelines, and key randomized controlled trials. A comprehensive literature search was conducted using databases such as PubMed, MEDLINE, and Google Scholar, focusing on publications from the last two decades with emphasis on high-quality studies, systematic reviews, and meta-analyses. Search terms included “cleft palate repair,” “palatoplasty techniques,” “Furlow Z-plasty,” “intravelar veloplasty,” “von Langenbeck,” “velopharyngeal insufficiency,” and “timing of cleft palate surgery.” Only English-language articles reporting original data on surgical techniques, outcomes, and complications in children were prioritized. Surgical techniques for cleft palate repair generally follow core principles: achieving tension-free anatomical closure of the hard and soft palate, reconstruction of the levator veli palatini muscle sling, palatal lengthening to optimize velopharyngeal closure, and minimization of maxillary growth restriction. The most commonly employed methods include the von Langenbeck palatoplasty, Bardach two-flap technique, Furlow double-opposing Z-plasty, and radical intravelar veloplasty (IVV), often used in combination depending on cleft width and morphology.[5,6]

In the von Langenbeck technique, bilateral relaxing incisions are made along the lateral aspects of the hard palate, and mucoperiosteal flaps are elevated based on the greater palatine vessels. These flaps are then mobilized medially for closure of the cleft, typically combined with intravelar veloplasty for muscle repositioning. This method is reliable for moderate to wide clefts but may involve more denuded bone surfaces.The Furlow double-opposing Z-plasty is particularly favored for soft palate repair. It involves creating opposing Z-shaped incisions on the oral and nasal sides of the soft palate, allowing transposition of flaps that reorients the levator muscles into a transverse sling while simultaneously lengthening the velum. This technique has demonstrated superior speech outcomes and lower rates of velopharyngeal insufficiency (VPI) in several comparative studies.Intravelar veloplasty, often performed radically as described by Sommerlad, focuses on meticulous dissection and retropositioning of the abnormally oriented palatal muscles without significant Z-plasty lengthening. It can be combined with two-flap hard palate closure for comprehensive repair. Recent modifications, such as the combined Sommerlad-Furlow (S-F) technique, aim to integrate the benefits of muscle reconstruction and palatal lengthening while reducing fistula formation in wider clefts.[7,8,]

Primary palatoplasty is typically performed between 6 and 18 months of age. Evidence from the Timing of Primary Surgery for Cleft Palate (TOPS) trial supports repair at approximately 6 months for improved speech outcomes compared to 12 months, without increased perioperative risk in otherwise healthy infants. All procedures are conducted under general anesthesia with meticulous perioperative management, including preoperative assessment by a multidisciplinary team, antibiotic prophylaxis, and postoperative feeding protocols to protect the repair.Outcomes assessed in the reviewed literature include fistula rates, speech intelligibility (using standardized tools such as the Pittsburgh Weighted Speech Scale), velopharyngeal function (via nasopharyngoscopy or videofluoroscopy), maxillary growth, and need for secondary surgery. Complication rates and long-term functional results are compared across techniques where data permit.[9]

Results

Surgical repair of congenital cleft palate demonstrates high rates of successful anatomical closure and functional improvement across contemporary techniques. In the analyzed literature, primary palatoplasty achieved complete closure of the palatal defect in 92–97% of pediatric patients on the first attempt. The incidence of postoperative oronasal fistula ranged from 3.8% to 12%, with lower rates observed when using techniques that combine radical muscle reconstruction and palatal lengthening. Velopharyngeal insufficiency (VPI) requiring secondary surgery occurred in 8–25% of cases, depending on the surgical method, cleft severity, and timing of repair.[8] Speech outcomes were significantly better with early repair (around 6 months of age) compared to delayed repair. The TOPS trial and subsequent meta-analyses reported normal or near-normal speech intelligibility in 78–85% of children repaired at 6 months versus 65–72% in those repaired at 12 months. Techniques incorporating Furlow double-opposing Z-plasty or radical intravelar veloplasty (Sommerlad technique) consistently showed superior velopharyngeal competence and reduced hypernasality.[9]

The von Langenbeck and Bardach two-flap techniques remain reliable for wider clefts, providing stable hard palate closure but with slightly higher rates of maxillary growth restriction and fistula formation compared to muscle-focused approaches. Combined techniques (e.g., two-flap hard palate closure with Furlow soft palate repair) yielded the most balanced results in terms of fistula prevention and speech development. Long-term follow-up data indicate that multidisciplinary management further improves outcomes, with fewer patients requiring secondary speech surgery.[10]

The following table summarizes key comparative outcomes from major studies and reviews:

Surgical Technique	Fistula Rate (%)	VPI / Secondary Surgery Rate (%)	Good/Excellent Speech Outcomes (%)	Maxillary Growth Impact	References
Von Langenbeck Palatoplasty	8–15	15–25	65–75	Moderate	[4], [5]
Furlow Double-Opposing Z-plasty	4–8	8–15	80–90	Minimal	[6], [7]
Radical Intravelar Veloplasty (Sommerlad)	5–10	10–18	75–88	Low	[5], [6]

Surgical Technique	Fistula Rate (%)	VPI / Secondary Surgery Rate (%)	Good/Excellent Speech Outcomes (%)	Maxillary Growth Impact	References
Combined Two-Flap + Furlow	3.8–9	9–16	82–92	Low-Moderate	[4], [7]

Overall, complication rates have declined over the past two decades due to refined techniques, improved perioperative care, and earlier intervention. However, outcomes remain influenced by cleft width, presence of associated syndromes, and adherence to multidisciplinary follow-up protocols.

Discussion

The results of this review confirm that modern surgical techniques for congenital cleft palate repair yield generally favorable outcomes, with high rates of anatomical closure and acceptable functional results. However, no single technique is universally superior, and outcomes are heavily influenced by cleft morphology, timing of surgery, surgeon experience, and the quality of multidisciplinary care.[11] Early primary palatoplasty at around 6 months of age, as supported by the TOPS trial, appears to offer better speech outcomes without significantly increasing perioperative risks. This finding challenges the traditional “rule of 10s” (repair at 10 months) and supports a shift toward earlier intervention in healthy infants. The improved velopharyngeal competence observed with earlier repair is likely due to better neuromuscular adaptation during critical periods of speech development.

Among the surgical techniques, the Furlow double-opposing Z-plasty stands out for its ability to simultaneously reconstruct the levator muscle sling and lengthen the soft palate, resulting in lower VPI rates and superior speech results. In contrast, the von Langenbeck technique remains valuable for wide clefts due to its reliable hard palate closure but is associated with higher fistula rates and greater potential for maxillary growth restriction because of more extensive denudation of palatal bone. Radical intravelar veloplasty (Sommerlad technique) emphasizes precise muscle dissection and retropositioning, offering good functional outcomes with minimal palatal scarring. Many contemporary surgeons prefer hybrid approaches — such as two-flap hard palate repair combined with Furlow soft palate reconstruction — to balance the strengths of each method.[12]Despite technical advances, challenges persist. Postoperative oronasal fistulas, though reduced to below 10% in high-volume centers, remain a significant concern in wide or bilateral clefts. Velopharyngeal insufficiency requiring secondary surgery (pharyngoplasty) still occurs in 8–25% of patients. Long-term maxillary hypoplasia and the need for orthognathic surgery in adolescence continue to be important considerations, particularly with techniques that involve extensive mucoperiosteal flap elevation.[13]

A key factor in optimizing results is the multidisciplinary cleft team approach. Close collaboration between plastic surgeons, speech-language pathologists, orthodontists,

otolaryngologists, and pediatricians enables timely identification and management of feeding difficulties, hearing problems, and speech delays. Standardized outcome assessment tools (e.g., Pittsburgh Weighted Speech Scale, nasopharyngoscopy) are essential for objective evaluation and quality improvement.[14] Limitations of current evidence include heterogeneity in study designs, variable follow-up periods, and the relatively small number of large-scale randomized trials. Most data come from single-center retrospective series, which may limit generalizability. Future research should focus on prospective, multicenter studies evaluating long-term craniofacial growth, patient-reported outcomes, and the role of emerging techniques such as minimally invasive approaches or tissue engineering.In conclusion, while significant progress has been made in the surgical management of congenital cleft palate, individualized treatment planning, early intervention, and continuous refinement of surgical techniques remain crucial to achieving optimal functional and aesthetic results in affected children.[15]

Conclusion

Surgical repair of congenital cleft palate remains a highly effective intervention that significantly improves feeding, speech development, hearing, and overall quality of life in affected children. Contemporary techniques, particularly those emphasizing levator muscle reconstruction (such as Furlow double-opposing Z-plasty and radical intravelar veloplasty), combined with early primary palatoplasty around 6 months of age, offer the best balance between anatomical closure, velopharyngeal competence, and minimal impact on maxillary growth.Although excellent outcomes are achievable in high-volume centers with multidisciplinary teams, challenges such as oronasal fistula, velopharyngeal insufficiency, and long-term craniofacial growth disturbances still require attention. Individualized surgical planning based on cleft width, morphology, and associated anomalies is essential. Ongoing advancements in surgical refinement, standardized outcome assessment, and prospective multicenter research will further enhance results. Ultimately, timely surgical intervention within a comprehensive care framework continues to be the cornerstone for achieving optimal functional and aesthetic outcomes in children with congenital cleft palate.

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