Manejo Integral de la Fisura Labiopalatina: Tiempos Quirúrgicos, Rehabilitación Velofaríngea y Resultados del Desarrollo a Largo Plazo

Comprehensive Management of Cleft Lip and Palate: Surgical Timing, Velopharyngeal Rehabilitation, and Long-Term Developmental Outcomes

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REUMEN

La fisura labiopalatina constituye una malformación craneofacial congénita compleja con repercusiones importantes sobre la producción del habla, la función auditiva, la alimentación, el crecimiento craneofacial y el desarrollo psicosocial. Aunque la reconstrucción quirúrgica representa un componente fundamental para corregir las alteraciones anatómicas, la obtención de resultados funcionales favorables a largo plazo requiere un abordaje multidisciplinario coordinado durante la infancia y adolescencia. Esta revisión narrativa tuvo como objetivo analizar críticamente la evidencia científica relacionada con la reconstrucción quirúrgica por etapas, la competencia velofaríngea y el seguimiento integral del desarrollo en pacientes pediátricos con fisura labiopalatina, incorporando investigaciones internacionales y aportaciones latinoamericanas. Se empleó un enfoque descriptivo, analítico y comparativo mediante la integración de 20 publicaciones científicas sobre tiempos quirúrgicos, técnicas reconstructivas, insuficiencia velofaríngea posoperatoria, resultados auditivos, desarrollo nutricional y calidad de vida. Los hallazgos identificaron una asociación entre la realización temprana de palatoplastia primaria y una menor frecuencia de insuficiencia velofaríngea, destacando un ensayo clínico multicéntrico que reportó tasas de 8.9% después de la intervención a los seis meses y 15.0% después de la intervención a los doce meses. Asimismo, la evidencia comparativa mostró diferencias en las tasas de fracaso funcional entre la técnica de Furlow con doble zetaplastia opuesta y la veloplastia intravelar de cierre lineal, aunque la heterogeneidad metodológica limitó las conclusiones definitivas sobre la superioridad quirúrgica. La disfunción velofaríngea persistente continuó representando una complicación relevante que requiere valoración individualizada y, en determinados casos, reconstrucción secundaria. La evidencia longitudinal también mostró cambios en los umbrales auditivos durante el crecimiento, mientras que los resultados nutricionales y antropométricos variaron según las características anatómicas y clínicas de los pacientes. Las investigaciones latinoamericanas destacaron la importancia de las condiciones sociodemográficas y del acceso a servicios especializados. En conjunto, los resultados respaldan un modelo de atención individualizado y fundamentado en evidencia que integre reconstrucción anatómica, rehabilitación funcional y vigilancia continua del desarrollo. Se requieren estudios prospectivos multicéntricos con medidas de resultado estandarizadas para fortalecer las recomendaciones clínicas y mejorar la función y calidad de vida a largo plazo.

PALABRAS CLAVE

Fisura labiopalatina, palatoplastia, reconstrucción quirúrgica por etapas, insuficiencia velofaríngea, resultados del habla, desarrollo craneofacial, otorrinolaringología pediátrica, atención multidisciplinaria, seguimiento del desarrollo, calidad de vida

ABSTRACT

Cleft lip and palate represent complex congenital craniofacial anomalies with significant implications for speech production, auditory function, feeding, craniofacial growth, and psychosocial development. Although reconstructive surgery remains fundamental to anatomical correction, optimal long-term outcomes require coordinated multidisciplinary management extending throughout childhood and adolescence. This narrative review aimed to critically examine the scientific evidence regarding staged surgical reconstruction, velopharyngeal competence, and comprehensive developmental follow-up in pediatric patients with cleft lip and palate, incorporating international research and contributions from Latin America. A descriptive, analytical, and comparative approach was adopted, integrating 20 scientific publications addressing surgical timing, reconstructive techniques, postoperative velopharyngeal insufficiency, auditory outcomes, nutritional development, and quality of life. The findings identified an association between earlier primary palatoplasty and reduced velopharyngeal insufficiency, with a multicenter randomized trial reporting postoperative insufficiency rates of 8.9% following repair at six months and 15.0% following repair at twelve months. Comparative evidence also demonstrated differences in functional failure rates between Furlow double-opposing Z-plasty and straight-line intravelar veloplasty, although methodological

heterogeneity limited definitive conclusions regarding surgical superiority. Persistent velopharyngeal dysfunction remained a clinically relevant complication requiring individualized assessment and, in selected cases, secondary reconstruction. Longitudinal evidence additionally demonstrated changes in auditory thresholds across childhood, while nutritional and growth outcomes varied according to anatomical characteristics and clinical circumstances. Latin American investigations emphasized the relevance of sociodemographic conditions and access to specialized services. Overall, the findings support an individualized, evidence-informed model of care integrating anatomical reconstruction, functional rehabilitation, and continuous developmental surveillance. Further prospective multicenter investigations using standardized outcome measures are required to strengthen clinical recommendations and improve long-term functional outcomes and quality of life.

KEYWORDS

Cleft lip and palate, palatoplasty, staged surgical reconstruction, velopharyngeal insufficiency, speech outcomes, craniofacial development, pediatric otolaryngology, multidisciplinary care, developmental follow-up, quality of life

INTRODUCCIÓN

Cleft lip and palate (CLP) are among the most significant congenital craniofacial anomalies, with implications extending beyond anatomical abnormalities to include feeding difficulties, speech disorders, hearing impairment, altered craniofacial growth, and psychosocial challenges. Their management represents a multidisciplinary challenge involving plastic surgery, pediatrics, otolaryngology, speech-language pathology, orthodontics, and developmental care. Although reconstructive techniques have evolved considerably, achieving satisfactory functional outcomes throughout childhood remains a central concern, particularly regarding velopharyngeal competence, speech intelligibility, and long-term quality of life (Badiee et al., 2026; Wadde et al., 2023).

The anatomical complexity of CLP varies according to the location, extent, and severity of the defect, influencing surgical planning and subsequent functional development. Primary reconstruction generally involves staged procedures designed to restore lip continuity, reconstruct palatal structures, and optimize the muscular mechanisms responsible for speech and swallowing. However, the optimal timing and sequence of surgical interventions remain subjects of clinical debate. The Timing of Primary Surgery for Cleft Palate (TOPS) trial demonstrated that the age at palatal closure can influence speech-related outcomes, emphasizing the importance of carefully balancing early functional rehabilitation against surgical considerations and craniofacial growth (Gamble et al., 2023). Similarly, systematic reviews comparing one-stage and two-stage palatal repair have identified substantial variability in treatment protocols and reported outcomes, highlighting the need for individualized surgical strategies (Cornefjord et al., 2023; Timbang et al., 2014).

One of the principal objectives of palatal reconstruction is restoring velopharyngeal function, which requires coordinated activity of the soft palate and pharyngeal walls to achieve appropriate separation between the oral and nasal cavities during speech. Persistent velopharyngeal insufficiency (VPI) may result in hypernasality, nasal air emission, reduced speech intelligibility, and compensatory articulation patterns, potentially affecting communication and social participation. Despite advances in techniques such as intravelar veloplasty and Furlow double-opposing Z-plasty, postoperative VPI remains an important complication. Evidence suggests that surgical technique, anatomical characteristics, associated conditions, and timing of intervention contribute to variability in functional outcomes (Xepoleas et al., 2023; Sainsbury et al., 2024). Secondary procedures, including palatal re-repair and pharyngeal surgery, may be necessary when primary reconstruction fails to achieve adequate velopharyngeal closure (Asar et al., 2023; Kurnik et al., 2020).

Beyond speech-related complications, children with CLP frequently experience otological and nutritional difficulties that require continuous monitoring. Eustachian tube dysfunction predisposes these patients to otitis media with effusion and conductive hearing loss, potentially interfering with language acquisition and educational performance. Consequently, audiological assessment and otolaryngological surveillance constitute essential components of multidisciplinary follow-up (Skuladottir et al., 2015; Téblick et al., 2019). Feeding difficulties may also affect nutritional status during infancy, while growth disturbances and psychosocial concerns can persist throughout childhood. Recent investigations have emphasized the relevance of individualized nutritional guidance, longitudinal

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growth assessment, and evaluation of patient-reported quality of life (Becker de Oliveira et al., 2024; Gallego Sobrino et al., 2021; Yusof & Mohd Ibrahim, 2023).

International evidence has contributed substantially to refining CLP treatment protocols; nevertheless, differences in healthcare infrastructure, access to specialized surgical services, and availability of long-term rehabilitation remain important considerations. Research conducted in Latin America has provided valuable information regarding surgical outcomes and regional challenges. In Peru, Rossell-Perry et al. (2021) examined the functional implications of intravelar veloplasty, contributing evidence relevant to palatal muscle reconstruction. Similarly, research from Brazil has highlighted the relationship between sociodemographic circumstances and speech outcomes, underscoring the importance of continuity of care and equitable access to multidisciplinary services (Araújo et al., 2022). These findings support the need to interpret international recommendations within different healthcare contexts rather than assuming that identical treatment pathways are feasible in every population.

Despite the growing body of scientific literature, important uncertainties persist concerning the most appropriate surgical sequence, the factors associated with postoperative velopharyngeal dysfunction, and the optimal integration of developmental surveillance into reconstructive care. Existing studies frequently evaluate surgical success through anatomical closure or isolated speech outcomes, whereas comprehensive long-term assessments incorporating hearing, nutrition, craniofacial development, and psychosocial well-being remain less consistently represented. This fragmentation complicates comparisons between treatment approaches and reinforces the importance of evaluating CLP as a condition requiring continuous, coordinated care rather than a series of independent surgical procedures (Lindeborg et al., 2020; Wadde et al., 2023).

Accordingly, the present narrative review aims to examine contemporary evidence concerning staged surgical reconstruction, velopharyngeal function, and comprehensive developmental follow-up in patients with cleft lip and palate. The guiding research question is how surgical timing, reconstructive techniques, and multidisciplinary surveillance contribute to functional and developmental outcomes across childhood. The review is organized around three complementary dimensions: primary and secondary reconstructive strategies, assessment and management of velopharyngeal dysfunction, and longitudinal monitoring of hearing, feeding, growth, speech, and psychosocial development. Evidence from international and Latin American studies is integrated to identify areas of clinical consensus, ongoing controversies, and opportunities for improving continuity of care. Through this approach, the review seeks to establish a clinically relevant framework for understanding CLP management as an evolving therapeutic process in which anatomical reconstruction and functional development must be considered interdependent objectives.

DESARROLLO

Cleft lip and palate (CLP) constitute a heterogeneous group of congenital craniofacial anomalies whose clinical management requires the integration of anatomical reconstruction, functional rehabilitation, and longitudinal developmental surveillance. Although surgical correction is essential for restoring the continuity of affected structures, anatomical closure alone does not guarantee adequate speech production, auditory function, or normal craniofacial development. Contemporary evidence increasingly supports a comprehensive therapeutic approach in which reconstructive procedures are coordinated with pediatric, otolaryngological, orthodontic, and speech-language interventions. The central challenge lies in determining how surgical timing, technical decisions, and continuity of care interact to influence functional outcomes throughout childhood (Badiee et al., 2026; Wadde et al., 2023).

Anatomical and Functional Complexity of Cleft Lip and Palate

The clinical manifestations of CLP depend on the extent of the anatomical defect, its laterality, the involvement of the primary or secondary palate, and the presence of associated congenital conditions. Unilateral and bilateral clefts may differ considerably in tissue displacement, muscular discontinuity, and maxillary architecture. These characteristics influence the complexity of reconstructive surgery and the likelihood of residual functional abnormalities.

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In cleft palate, the abnormal arrangement of the levator veli palatini muscles represents a particularly important determinant of velopharyngeal dysfunction. Rather than forming an effective muscular sling, these fibers may insert abnormally along the posterior margins of the hard palate, compromising the elevation and posterior movement of the soft palate during speech. Consequently, successful palatal reconstruction requires not only mucosal closure but also appropriate muscular repositioning to restore the physiological mechanisms responsible for separating the oral and nasal cavities (Timbang et al., 2014; Lindeborg et al., 2020).

The functional consequences extend into the early stages of childhood development. Infants may experience feeding difficulties associated with inadequate oral pressure generation, while older children may develop articulation disorders, abnormal resonance, and recurrent middle-ear disease. These manifestations frequently coexist, illustrating why isolated surgical assessment cannot adequately characterize the overall burden of CLP. Comprehensive evaluation must therefore incorporate anatomical severity, functional performance, and developmental progression.

Staged Surgical Reconstruction and Timing of Intervention

Surgical treatment is generally organized into sequential procedures adapted to the child's age, anatomical characteristics, and functional requirements. Primary cheiloplasty is commonly performed during early infancy, while palatoplasty is subsequently undertaken to reconstruct the palatal tissues and establish conditions favorable for speech development. Additional procedures, including alveolar bone grafting, secondary palatal correction, orthognathic surgery, and definitive nasal reconstruction, may be indicated during later developmental stages.

The selection of surgical timing remains clinically significant because early intervention may promote functional development, whereas operative decisions must also consider tissue growth, anesthetic safety, and the potential need for subsequent reconstruction. The multicenter TOPS trial provided important evidence concerning palatal repair timing, identifying differences in velopharyngeal insufficiency outcomes between children undergoing surgery at different ages. These findings support the clinical relevance of early functional intervention while emphasizing the need to interpret surgical timing within the broader context of patient characteristics and postoperative follow-up (Gamble et al., 2023).

Comparative studies have also evaluated one-stage and two-stage palatal repair. Although both approaches aim to obtain effective anatomical closure and functional rehabilitation, differences in surgical sequencing may influence speech outcomes, fistula formation, and maxillary development. Cornefjord et al. (2023) highlighted the methodological heterogeneity of available studies, which limits definitive conclusions regarding the superiority of a single protocol.

Similarly, the comparison between Furlow double-opposing Z-plasty and straight-line intravelar veloplasty demonstrates that surgical effectiveness depends on multiple anatomical and technical variables rather than procedure selection alone. The systematic review by Timbang et al. (2014) emphasized the importance of reconstructing functional palatal musculature and assessing speech-related outcomes when comparing surgical techniques.

These findings suggest that staged reconstruction should be understood as an individualized therapeutic sequence, rather than a rigid chronological protocol. The ultimate objective is to maintain an appropriate relationship between anatomical correction, velopharyngeal competence, craniofacial growth, and long-term functional stability.

Velopharyngeal Function and Postoperative Speech Outcomes

Velopharyngeal competence is essential for normal speech production. During the articulation of oral sounds, coordinated movement of the soft palate and pharyngeal walls establishes separation between the oral and nasal cavities, allowing the generation of appropriate intraoral pressure. Failure of this mechanism may produce hypernasality, nasal air emission, weakened consonant production, and compensatory articulation patterns.

Persistent velopharyngeal insufficiency represents one of the most clinically relevant complications following palatoplasty. Its occurrence may be associated with insufficient palatal length, incomplete muscular reconstruction, unfavorable anatomical relationships, or associated developmental conditions. A systematic review by Xepoleas et al. (2023) examined postoperative VPI in relation to surgical timing and technique, demonstrating the importance of evaluating functional outcomes rather than relying exclusively on anatomical closure.

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Speech assessment requires a multidimensional approach that incorporates perceptual evaluation of resonance, articulation, and intelligibility, complemented by instrumental examination when clinically indicated. Nasopharyngoscopy and videofluoroscopy can provide information about velopharyngeal movement patterns, residual closure gaps, and anatomical limitations that may influence treatment selection. Speech-language evaluation is also essential for distinguishing structural insufficiency from articulation errors that may respond to targeted rehabilitation (Lindeborg et al., 2020; Asar et al., 2023).

When significant VPI persists despite primary repair, secondary surgical interventions may be considered. Available approaches include palatal re-repair, pharyngeal flap procedures, sphincter pharyngoplasty, and other techniques selected according to the anatomical mechanism of dysfunction. Kurnik et al. (2020) reported that palatal re-repair may improve velopharyngeal outcomes in selected patients, although treatment effectiveness varies according to individual characteristics and the criteria used to evaluate surgical success.

Importantly, improvement in velopharyngeal closure does not necessarily correspond to immediate normalization of speech. Compensatory articulation patterns may persist after structural correction, requiring continued speech-language intervention. Consequently, the evaluation of reconstructive effectiveness should incorporate both physiological competence and functional communication outcomes.

Otolaryngological Complications and Auditory Development

Children with cleft palate frequently experience Eustachian tube dysfunction related to alterations in palatal muscular anatomy and middle-ear ventilation. These abnormalities increase susceptibility to otitis media with effusion and conductive hearing loss, which may persist or recur during childhood.

Auditory impairment is particularly concerning during periods of rapid speech and language acquisition. Even fluctuating conductive hearing loss may reduce auditory access to linguistic information, potentially complicating phonological development and communication. Skuladottir et al. (2015) documented the relevance of hearing outcomes in patients with cleft lip and palate, reinforcing the need for systematic audiological surveillance.

The relationship between surgical repair and middle-ear function remains complex. Although reconstruction of palatal musculature may contribute to improved Eustachian tube mechanics, palatoplasty does not consistently eliminate middle-ear disease. Téblick et al. (2019) examined the effects of palatal closure techniques on speech and middle-ear outcomes, illustrating the importance of evaluating both domains independently.

Longitudinal otolaryngological management should therefore include age-appropriate hearing assessments, middle-ear evaluation, and timely treatment of clinically significant auditory abnormalities. Decisions regarding tympanostomy tubes or other interventions must be individualized according to hearing thresholds, persistence of effusion, developmental vulnerability, and associated complications.

Nutritional Status, Craniofacial Growth, and Pediatric Development

Feeding difficulties constitute an important concern during the neonatal period and early infancy, particularly in children with palatal involvement. Inadequate separation between the oral and nasal cavities can interfere with suction generation and feeding efficiency, potentially increasing feeding duration and affecting nutritional intake.

Specialized feeding strategies, caregiver education, and nutritional monitoring are therefore essential components of early management. Becker de Oliveira et al. (2024) examined breastfeeding in children with cleft lip and palate, emphasizing the need to adapt feeding recommendations to anatomical and functional limitations rather than applying uniform approaches.

Growth surveillance should extend beyond the immediate postoperative period. Children with CLP may experience variations in weight gain, linear growth, and craniofacial development influenced by nutritional difficulties, associated conditions, and treatment-related factors. Gallego Sobrino et al. (2021) reviewed long-term growth patterns in this population, highlighting the importance of longitudinal assessment rather than isolated anthropometric measurements.

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Craniofacial growth also represents a fundamental consideration in reconstructive planning. Surgical interventions must balance the need for early functional restoration against potential effects on maxillary development. Orthodontic and maxillofacial assessment becomes increasingly relevant during mixed dentition and adolescence, when alveolar reconstruction, dental alignment, and skeletal discrepancies may require additional treatment.

Psychosocial Development and Quality of Life

The consequences of CLP extend beyond physical and physiological function. Facial appearance, speech differences, repeated clinical appointments, and multiple surgical procedures may influence social interaction, self-perception, and emotional well-being during childhood and adolescence.

Psychosocial experiences are heterogeneous and cannot be explained solely by anatomical severity. Family support, communication abilities, school environment, access to specialized services, and individual coping mechanisms may contribute to developmental adjustment. Yusof and Mohd Ibrahim (2023) identified multiple dimensions of quality of life affected by cleft-related conditions, supporting the incorporation of psychosocial indicators into clinical follow-up.

Comprehensive treatment should therefore include developmentally appropriate psychological assessment, caregiver involvement, and opportunities for children and adolescents to participate in decisions concerning their care. Such measures are particularly important when considering elective secondary procedures, where functional expectations and personal priorities may differ between patients and healthcare professionals.

International Evidence and Latin American Perspectives

Clinical outcomes in CLP management are influenced not only by surgical expertise but also by the organization and accessibility of healthcare services. Specialized multidisciplinary teams facilitate coordinated treatment planning, whereas fragmented systems may contribute to delayed interventions, interrupted rehabilitation, and inconsistent long-term surveillance.

Evidence from Latin America provides an important perspective on these challenges. Rossell-Perry et al. (2021) evaluated intravelar veloplasty in patients with unilateral cleft lip and palate, contributing clinical information regarding reconstructive techniques and functional outcomes in Peru. In Brazil, Araújo et al. (2022) examined speech outcomes alongside sociodemographic characteristics, highlighting the importance of considering geographical and social circumstances in treatment evaluation.

These contributions demonstrate that favorable outcomes depend on more than the technical completion of surgical procedures. Access to experienced reconstructive teams, speech-language services, audiological monitoring, nutritional counseling, and coordinated follow-up may substantially influence the continuity and effectiveness of care.

Nevertheless, variations in study design, outcome definitions, follow-up duration, and healthcare infrastructure complicate direct comparisons between international populations. Consequently, the adaptation of clinical recommendations to Latin American settings requires consideration of local resources and barriers while preserving evidence-based standards of treatment.

Integration of Surgical and Developmental Outcomes

The available literature indicates that the effectiveness of CLP management cannot be adequately determined through isolated measurements of surgical success. Anatomical closure, velopharyngeal competence, auditory function, nutritional status, craniofacial development, and psychosocial well-being represent interrelated dimensions of a broader therapeutic process.

A clinically meaningful assessment should therefore combine objective anatomical and functional findings with developmental outcomes and patient-centered measures. This integrated approach is particularly relevant because favorable results in one domain do not necessarily predict equivalent improvement in another. A child may demonstrate satisfactory palatal closure while experiencing persistent hypernasality, conductive hearing loss, or difficulties with social participation.

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Accordingly, long-term multidisciplinary surveillance should be considered an essential component of treatment rather than an optional extension of reconstructive surgery. The coordination of plastic surgery, pediatrics, otolaryngology, speech-language pathology, orthodontics, nutrition, and psychosocial services provides a framework for identifying complications early and adapting interventions to changing developmental needs (Badiee et al., 2026; Wadde et al., 2023).

OBJETIVO GENERAL Y OBJETIVOS ESPECÍFICOS

General Objective

To critically analyze current scientific evidence regarding staged surgical reconstruction, velopharyngeal function, and comprehensive developmental follow-up in pediatric patients with cleft lip and palate, integrating anatomical, functional, audiological, nutritional, and psychosocial perspectives to identify evidence-based strategies that support individualized treatment planning, multidisciplinary clinical decision-making, and improved long-term developmental outcomes.

Specific Objectives

Cognitive Domain: Knowledge, Analysis, Evaluation, and Synthesis

- **To identify** the embryological, anatomical, and physiological characteristics of cleft lip and palate, recognizing their relationship with feeding difficulties, speech abnormalities, auditory dysfunction, and craniofacial growth disturbances.

- **To analyze** the scientific evidence concerning primary and secondary reconstructive procedures, comparing surgical timing, technical approaches, postoperative complications, and functional outcomes.

- **To evaluate** the factors associated with velopharyngeal insufficiency following palatoplasty, including anatomical characteristics, muscular reconstruction, and the effectiveness of secondary interventions.

- **To synthesize** international and Latin American findings regarding long-term developmental outcomes, identifying areas of clinical consensus, methodological limitations, and unresolved questions.

Psychomotor Domain: Clinical Application and Procedural Skills

- **To distinguish** the principal surgical techniques employed in staged cleft reconstruction according to their anatomical objectives, technical characteristics, and functional indications.

- **To organize** the essential components of a comprehensive clinical assessment, including evaluation of palatal integrity, speech production, auditory function, nutritional status, and craniofacial development.

- **To formulate** evidence-informed clinical pathways for postoperative surveillance and referral, integrating surgical findings with speech-language, otolaryngological, pediatric, and orthodontic assessments.

- **To demonstrate**, through the structured interpretation of published clinical protocols, how reconstructive and rehabilitation strategies may be coordinated across different developmental stages.

Affective Domain: Professional Values, Patient-Centered Care, and Multidisciplinary Collaboration

- **To recognize** the importance of family participation, ethical clinical decision-making, and individualized treatment expectations in the management of pediatric patients with cleft lip and palate.

- **To value** interdisciplinary collaboration as a fundamental component of comprehensive care, acknowledging the contributions of surgical, pediatric, audiological, nutritional, psychological, and rehabilitation professionals.

- **To promote** sensitivity toward the psychosocial challenges associated with craniofacial differences, speech limitations, repeated surgical interventions, and potential barriers to social participation.

- **To advocate** for equitable access to specialized services and sustained developmental follow-up, particularly in healthcare environments where geographical, socioeconomic, and institutional barriers may influence treatment continuity.

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OBJETO DE ESTUDIO

The object of study of this narrative review is the comprehensive surgical and developmental management of pediatric patients with cleft lip and palate (CLP), with particular emphasis on staged reconstructive procedures, restoration of velopharyngeal competence, and longitudinal assessment of functional outcomes. This congenital craniofacial condition constitutes a complex clinical phenomenon in which anatomical abnormalities interact with feeding mechanisms, speech production, auditory function, craniofacial growth, and psychosocial development. Consequently, its evaluation requires an integrated perspective that extends beyond the immediate results of surgical reconstruction (Badiee et al., 2026; Wadde et al., 2023).

The population of interest comprises infants, children, and adolescents diagnosed with unilateral or bilateral cleft lip and palate, including individuals with isolated palatal clefts and combined cleft deformities. Particular attention is directed toward patients undergoing primary cheiloplasty, palatoplasty, secondary correction of velopharyngeal insufficiency, and subsequent rehabilitative interventions. Although anatomical presentation and associated medical conditions may vary, the review focuses primarily on the relationship between reconstructive strategies and functional development throughout childhood.

The principal analytical dimensions include surgical timing, reconstructive technique, palatal muscular restoration, postoperative velopharyngeal function, speech intelligibility, auditory outcomes, feeding capacity, nutritional development, and craniofacial growth. These variables are examined as interconnected components of clinical management rather than independent outcomes. Evidence regarding palatal repair timing and postoperative speech function provides a foundation for evaluating how surgical decisions may influence subsequent developmental trajectories (Gamble et al., 2023; Xepoleas et al., 2023).

A complementary dimension involves the organization of multidisciplinary healthcare services and their contribution to treatment continuity. Coordination among plastic surgeons, pediatricians, otolaryngologists, speech-language pathologists, orthodontists, nutrition specialists, and mental health professionals is considered essential for identifying functional limitations and adapting therapeutic strategies across different developmental stages. The inclusion of studies conducted in Latin America additionally allows consideration of geographical, socioeconomic, and institutional circumstances that may influence access to specialized treatment and long-term follow-up (Rossell-Perry et al., 2021; Araújo et al., 2022).

The unit of analysis consists of published scientific evidence addressing surgical interventions, functional outcomes, and multidisciplinary follow-up in pediatric CLP populations. The review examines relationships reported in previous investigations without directly recruiting patients, implementing experimental interventions, or collecting individual clinical information. Accordingly, the object of study is defined not simply as the congenital anomaly itself, but as the continuum of reconstructive and developmental care required to optimize functional recovery and long-term well-being.

Through this perspective, the investigation seeks to establish how surgical reconstruction and comprehensive developmental monitoring contribute to the management of CLP, while identifying factors that may explain differences in clinical outcomes and opportunities for improving integrated care.

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METODOLOGÍA

Study Design and Methodological Approach

This study was structured as a **narrative literature review with a descriptive, analytical, and comparative approach**, guided by the scientific method and principles of evidence-based medicine. The methodological framework was designed to examine the relationship between staged surgical reconstruction, velopharyngeal function, and comprehensive developmental follow-up in pediatric patients with cleft lip and palate (CLP). Rather than evaluating a single surgical intervention, the review considers reconstructive treatment as a longitudinal process involving anatomical restoration, functional rehabilitation, and multidisciplinary surveillance.

The scientific method was selected as the organizing framework because it enables the systematic formulation of research questions, identification of relevant evidence, critical examination of published findings, and development of conclusions supported by existing scientific knowledge. The review follows a nonexperimental, retrospective documentary design, using previously published research without direct patient recruitment, clinical interventions, or individual-level data collection.

Research Question and Analytical Framework

The central research question was formulated as follows: *How do surgical timing, reconstructive techniques, and multidisciplinary developmental follow-up influence velopharyngeal function and long-term clinical outcomes in pediatric patients with cleft lip and palate?*

This question was organized using an adapted Population–Concept–Context (PCC) framework. The population comprised infants, children, and adolescents with cleft lip, cleft palate, or combined cleft deformities. The principal concepts included staged surgical reconstruction, velopharyngeal competence, speech outcomes, auditory function, craniofacial growth, nutritional development, and psychosocial well-being. The context encompassed international multidisciplinary healthcare settings, with particular consideration of clinical evidence originating from Latin America.

The analytical assumption guiding the review was that successful management of CLP depends not exclusively on anatomical closure, but on the interaction between appropriate reconstructive planning, restoration of palatal muscular function, early identification of complications, and continuity of developmental care.

Sources of Information and Literature Search Strategy

The literature search framework prioritized peer-reviewed biomedical publications indexed in PubMed/MEDLINE and Scopus, with complementary consideration of articles published in established craniofacial surgery, otolaryngology, pediatric, and rehabilitation journals.

The proposed search strategy combined controlled vocabulary and free-text terms related to the condition, surgical management, functional outcomes, and multidisciplinary follow-up. Representative search expressions included:

- “Cleft lip and palate” AND “surgical repair” AND “timing”.
- “Palatoplasty” AND “velopharyngeal insufficiency” AND “speech outcomes”.
- “Cleft palate” AND “intravelar veloplasty” OR “Furlow palatoplasty”.
- “Cleft lip and palate” AND “hearing” AND “development”.
- “Cleft palate” AND “multidisciplinary care” AND “long-term outcomes”.
- “Cleft lip and palate” AND “Latin America” OR “Brazil” OR “Peru”.

Publications from 2014 through 2026 were considered relevant to the review framework, allowing the integration of established reconstructive techniques with more recent clinical evidence. Studies from earlier years could be considered when necessary to clarify foundational surgical principles.

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Eligibility Criteria and Evidence Selection

The methodological framework established eligibility criteria based on relevance, scientific quality, and applicability to pediatric CLP management. Eligible publications included systematic reviews, meta-analyses, randomized clinical trials, prospective and retrospective observational studies, comparative surgical investigations, and clinically relevant narrative reviews.

Articles were considered relevant when they addressed at least one of the following dimensions: timing and sequencing of reconstructive surgery, palatal muscle reconstruction, velopharyngeal insufficiency, speech development, otological complications, nutritional status, craniofacial growth, quality of life, or multidisciplinary follow-up.

Publications focusing exclusively on adult aesthetic procedures, unrelated craniofacial anomalies, or outcomes without a clear relationship to cleft management were considered outside the principal scope. Greater interpretive weight was assigned to studies with clearly defined populations, transparent methodology, clinically relevant outcomes, and appropriate follow-up periods.

The review framework incorporates a core bibliography of 20 scientific publications selected for their thematic relevance. The available documentation does not establish a complete database search history, screening counts, or formal risk-of-bias assessments; therefore, the study is characterized as a narrative review rather than a systematic review or meta-analysis.

Data Extraction and Organization

Information from the selected publications was organized into predefined analytical categories to facilitate comparison across studies. These categories included study design, geographical setting, patient population, reconstructive technique, surgical timing, functional outcome measures, complications, and follow-up considerations.

Particular attention was directed toward outcomes associated with velopharyngeal competence, speech intelligibility, postoperative fistula formation, auditory function, feeding difficulties, and craniofacial development. Additional information concerning healthcare access, multidisciplinary coordination, and geographical differences was considered when reported.

The resulting evidence was organized into three principal domains: reconstructive strategies and operative sequencing; velopharyngeal function and related complications; and comprehensive developmental outcomes. This structure allows the relationship between surgical management and long-term pediatric care to be examined without assuming that studies using different populations or outcome measures are directly comparable.

Evidence Appraisal and Synthesis

A qualitative thematic synthesis was selected because of the anticipated heterogeneity in study designs, surgical procedures, outcome definitions, and duration of follow-up. Findings were compared according to their clinical relevance, consistency across publications, and methodological limitations.

Randomized trials and systematic reviews were considered particularly informative for evaluating comparative treatment questions, while observational investigations contributed information regarding functional recovery, regional healthcare conditions, and long-term clinical outcomes. Narrative reviews were used primarily to contextualize established concepts and identify broader considerations in multidisciplinary care.

The synthesis emphasized similarities and differences between published findings without calculating pooled effect estimates or generating new patient-level statistics. Where evidence was inconsistent, the interpretation considered potential differences in patient selection, cleft severity, operative technique, assessment methods, and follow-up duration.

Reproducibility and Methodological Limitations

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Reproducibility was addressed by defining the research question, population, thematic scope, search expressions, eligibility criteria, analytical categories, and synthesis strategy. These elements provide a framework that other investigators can apply when conducting an updated or more comprehensive literature review.

However, complete reproducibility of a database search would additionally require the exact search dates, database-specific queries, retrieval counts, duplicate-removal procedures, and a documented record of study selection. These details should be recorded if the review is subsequently expanded into a formal systematic investigation.

The principal methodological limitations of the narrative approach include potential selection bias, heterogeneity between studies, and the absence of quantitative pooled estimates. Nevertheless, this design is appropriate for integrating clinical evidence across multiple specialties and examining a condition whose management extends beyond individual surgical procedures.

Ethical Considerations

This investigation is based exclusively on previously published scientific literature and does not involve direct contact with patients, experimental interventions, or access to identifiable clinical records. Consequently, patient recruitment and informed consent procedures are not applicable to the review itself.

FASES DEL DESARROLLO

Identification and Delimitation of the Research Problem

The initial phase focused on identifying the principal clinical challenges associated with CLP management. Although reconstructive surgery has improved anatomical correction, persistent difficulties involving speech production, velopharyngeal competence, hearing, feeding, and craniofacial growth demonstrate that surgical closure cannot be considered the sole indicator of therapeutic success.

The research problem was therefore delimited to the relationship between reconstructive strategies and long-term functional outcomes, emphasizing the interaction between surgical timing, technical approaches, postoperative complications, and multidisciplinary surveillance.

Previous research has demonstrated that clinical outcomes vary according to operative timing, surgical technique, and patient-related characteristics. The TOPS trial provided comparative evidence concerning the timing of primary palatal repair, while systematic reviews have examined the occurrence of postoperative velopharyngeal insufficiency and differences between reconstructive approaches (Gamble et al., 2023; Xepoleas et al., 2023; Cornefjord et al., 2023).

These findings established the rationale for examining CLP as a longitudinal condition requiring coordinated surgical and developmental management.

Formulation of the Research Question and Analytical Assumptions

Following identification of the problem, the central research question was established to investigate how surgical timing, reconstructive techniques, and multidisciplinary follow-up contribute to functional recovery and developmental outcomes.

Three complementary analytical assumptions guided the investigation. First, the timing and technical characteristics of palatal reconstruction may influence subsequent velopharyngeal competence and speech development. Second, favorable anatomical outcomes do not necessarily guarantee satisfactory auditory, nutritional, or psychosocial development. Third, coordinated multidisciplinary surveillance may facilitate earlier identification of complications and more appropriate adaptation of treatment strategies.

These assumptions were derived from previously published clinical evidence and were used to organize the interpretation of findings rather than to conduct formal statistical hypothesis testing (Sainsbury et al., 2024; Téblick et al., 2019; Badiee et al., 2026).

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Identification and Organization of Scientific Evidence

The literature identification phase was structured around the thematic search strategy described in the methodology. PubMed/MEDLINE and Scopus were designated as the principal databases, with search concepts encompassing cleft lip and palate, palatoplasty, reconstructive surgery, velopharyngeal insufficiency, speech outcomes, hearing, feeding, and multidisciplinary care.

The review incorporated a core bibliography of 20 publications addressing the principal dimensions of the research problem. Relevant evidence included randomized trials, systematic reviews, meta-analyses, comparative investigations, observational studies, and clinical reviews.

The selected literature was organized into three major categories: surgical reconstruction and treatment sequencing; velopharyngeal competence and speech-related complications; and longitudinal developmental outcomes. Research originating from Latin America was considered alongside international evidence to incorporate regional perspectives on reconstructive approaches, clinical outcomes, and healthcare accessibility (Rossell-Perry et al., 2021; Araújo et al., 2022).

This phase established the documentary foundation for the review. Because a complete search log and screening record were not available, the selected publications were treated as a narrative evidence base rather than the result of an exhaustive systematic search.

Critical Examination of Reconstructive Strategies

The surgical analysis phase examined the objectives, timing, and functional implications of primary and secondary reconstructive procedures. Particular attention was given to palatal muscle repositioning, restoration of anatomical continuity, prevention of oronasal fistulas, and preservation of conditions favorable for speech and craniofacial development.

Evidence concerning early versus later palatal repair was evaluated alongside studies comparing one-stage and two-stage procedures. The TOPS trial provided an important basis for assessing the relationship between surgical timing and velopharyngeal outcomes, while comparative reviews contributed information regarding differences between reconstructive techniques (Gamble et al., 2023; Timbang et al., 2014; Cornefjord et al., 2023).

The analysis emphasized that reconstructive effectiveness should not be determined exclusively by the achievement of anatomical closure. Instead, surgical results must be considered in relation to speech development, postoperative complications, and the potential requirement for subsequent interventions.

Evaluation of Velopharyngeal Function and Associated Complications

The subsequent phase focused on the functional consequences of palatal reconstruction, particularly the occurrence and management of velopharyngeal insufficiency.

Published findings were examined according to the mechanisms of velopharyngeal closure, characteristics of postoperative dysfunction, speech outcomes, and indications for secondary correction. The analysis considered the distinction between structural insufficiency and learned compensatory articulation patterns, recognizing that these conditions may require different therapeutic approaches.

Systematic reviews addressing postoperative insufficiency and secondary palatal procedures provided a foundation for comparing available management strategies. Evidence from Xepoleas et al. (2023), Asar et al. (2023), and Kurnik et al. (2020) supported the examination of individualized treatment selection and the importance of functional reassessment following surgery.

This phase also incorporated the role of perceptual speech evaluation and instrumental assessment in determining the nature of residual velopharyngeal dysfunction.

Integration of Pediatric and Otolaryngological Outcomes

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The developmental analysis phase examined clinical dimensions extending beyond surgical reconstruction, including hearing, nutritional status, growth, communication, and psychosocial well-being.

Otological evidence was reviewed to clarify the relationship between palatal abnormalities, Eustachian tube dysfunction, middle-ear disease, and conductive hearing loss. Nutritional investigations contributed information regarding feeding challenges during infancy, while longitudinal growth studies informed the assessment of developmental surveillance requirements (Skuladottir et al., 2015; Becker de Oliveira et al., 2024; Gallego Sobrino et al., 2021).

Psychosocial outcomes were considered in relation to communication difficulties, repeated treatment experiences, and quality of life. The analysis recognized that developmental well-being cannot be inferred solely from surgical or anatomical findings, reinforcing the need for patient-centered multidisciplinary evaluation (Yusof & Mohd Ibrahim, 2023).

Comparative Interpretation of International and Latin American Evidence

A complementary analytical phase addressed differences between international treatment settings and the clinical experiences reported in Latin America.

Studies from Peru and Brazil were incorporated to examine reconstructive techniques, speech outcomes, and the relevance of sociodemographic factors in clinical management. Rossell-Perry et al. (2021) contributed evidence concerning intravelar veloplasty, whereas Araújo et al. (2022) examined speech-related outcomes within a Brazilian healthcare context.

These findings were interpreted alongside international investigations to identify shared clinical priorities and potential differences in treatment continuity. Particular consideration was given to the availability of multidisciplinary teams, access to specialized rehabilitation, geographical barriers, and the feasibility of prolonged developmental surveillance.

Because healthcare systems, study populations, and outcome measures differ, regional comparisons were approached descriptively without assuming direct equivalence between studies.

Synthesis and Integration of Findings

The final phase consisted of organizing the reviewed evidence into an integrated clinical interpretation. Findings from the surgical, functional, pediatric, otolaryngological, and psychosocial domains were examined collectively to identify relationships between reconstructive decisions and long-term developmental outcomes.

The synthesis considered areas of agreement, conflicting findings, and limitations associated with differences in study design, surgical protocols, follow-up periods, and outcome definitions. Greater emphasis was placed on clinically relevant conclusions supported by comparative studies and systematic reviews, while observational investigations were used to contextualize developmental and regional considerations.

The resulting framework positions CLP management as a continuous therapeutic process involving anatomical reconstruction, functional assessment, complication surveillance, and multidisciplinary rehabilitation.

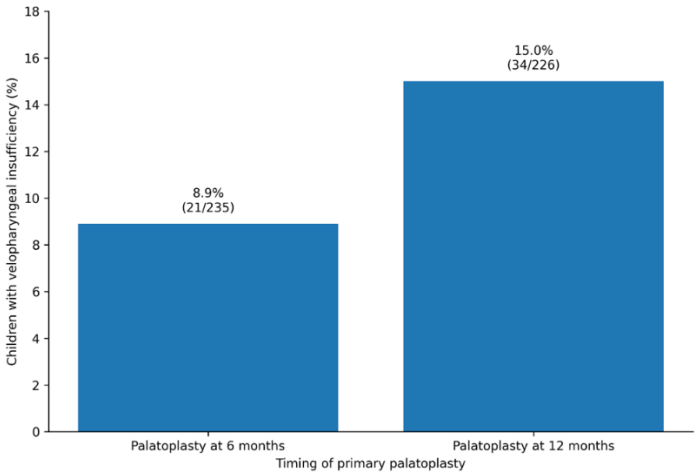
RESULTADOS Y DISCUSIÓN

Figure 1.

Influence of Primary Palatoplasty Timing on Velopharyngeal Insufficiency

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The figure presents the proportion of children with **velopharyngeal insufficiency (VPI) at 5 years of age** according to the timing of primary palatoplasty in the TOPS trial. Two groups were compared: children who underwent palatal repair at **6 months of age** and those who underwent repair at **12 months of age**. The outcome shown corresponds to the primary endpoint reported in the study, defined as insufficient velopharyngeal function at 5 years based on the velopharyngeal composite summary score used by the investigators (Gamble et al., 2023).

As shown in the figure, **8.9%** of children in the **6-month group** presented VPI at 5 years, corresponding to **21 of 235** analyzable participants. In contrast, **15.0%** of children in the **12-month group** showed VPI, corresponding to **34 of 226** analyzable participants (Gamble et al., 2023). In descriptive terms, the later-surgery group demonstrated a visibly higher proportion of postoperative velopharyngeal dysfunction than the earlier-surgery group. The absolute difference between groups was **6.1 percentage points**, with a lower frequency of insufficient velopharyngeal function observed among children who received earlier repair.

The figure also reflects the distribution of analyzable speech outcomes within the broader randomized trial population. Gamble et al. (2023) reported that **558 infants** from **23 centers in Europe and South America** were randomized, with **281 infants assigned to surgery at 6 months** and **277 assigned to surgery at 12 months**. Among these, the primary speech outcome at 5 years was analyzable in **83.6%** of the 6-month group and **81.6%** of the 12-month group, which supports the direct comparison displayed in the graph. Thus, the plotted values are not estimated or hypothetical proportions, but reported trial data derived from the children whose speech recordings were available for final analysis.

From a results perspective, the comparative pattern shown in the figure is consistent with the trial's main quantitative analysis. Gamble et al. (2023) reported a **risk ratio of 0.59** for VPI in the 6-month group compared with the 12-month group, with a **95% confidence interval of 0.36 to 0.99** and a **P value of 0.04**. These data indicate that the frequency of insufficient velopharyngeal function was lower in the earlier-repair group within the analyzed cohort. The graph visually summarizes that difference by showing a shorter bar for surgery at 6 months and a taller bar for surgery at 12 months, allowing the reader to identify the relative distribution of the primary outcome without requiring direct consultation of the original trial table.

In addition to the primary outcome, the study reported that postoperative complications were **infrequent and similar** in both groups, although these variables are not represented in the current figure because the present graph is restricted to VPI frequency at 5 years (Gamble et al., 2023). Therefore, Figure 1 specifically captures the principal comparative speech-related endpoint and serves as a focused representation of how the timing of primary palatoplasty was associated with different observed frequencies of velopharyngeal insufficiency in the analyzed population.

Figure 2.

Functional Outcomes Associated With Primary Palatoplasty Techniques

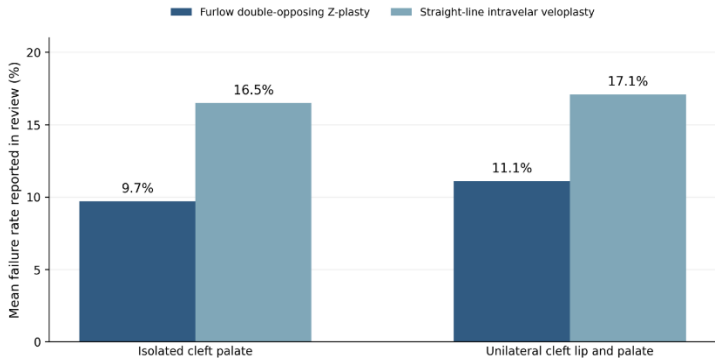


Figure 2 presents a comparative analysis of functional failure rates associated with two established techniques for primary cleft palate reconstruction: Furlow double-opposing Z-plasty and straight-line intravelar veloplasty. The comparison is based on the systematic review conducted by Timbang et al. (2014), which included 12 studies examining speech-related outcomes following primary palatal repair. Results were stratified according to two anatomical presentations: isolated cleft palate and unilateral cleft lip and palate. This classification allows differences in reported surgical outcomes to be examined while accounting for the distinct anatomical characteristics of the populations evaluated.

Among patients with isolated cleft palate, the mean failure rate was **9.7% following Furlow double-opposing Z-plasty**, compared with **16.5% following straight-line intravelar veloplasty**. This corresponds to an absolute difference of 6.8 percentage points between the two techniques. The lower reported failure rate in the Furlow group represents a consistent descriptive pattern in the reviewed studies, although these aggregated values do not independently establish a statistically significant difference within this anatomical subgroup (Timbang et al., 2014).

A similar distribution was observed among patients with unilateral cleft lip and palate. The mean failure rate associated with Furlow double-opposing Z-plasty was **11.1%**, whereas straight-line intravelar veloplasty demonstrated a mean failure rate of **17.1%**. The absolute difference between techniques was 6.0 percentage points. In this subgroup, the original systematic review also identified a statistically significant difference in the odds of requiring secondary surgery for velopharyngeal insufficiency, with a reported *p* value of 0.03 favoring the Furlow technique (Timbang et al., 2014).

When comparing anatomical subgroups within each surgical technique, the reported failure rates demonstrated relatively modest variation. For Furlow double-opposing Z-plasty, the mean failure rate increased from 9.7% in isolated cleft palate to 11.1% in unilateral cleft lip and palate, representing a difference of 1.4 percentage points. Similarly, straight-line intravelar veloplasty showed an increase from 16.5% to 17.1%, corresponding to a difference of 0.6 percentage points. These values indicate that the between-technique differences were more pronounced than the descriptive differences between the two anatomical categories represented in the figure.

The surgical approaches differ in their methods of restoring palatal anatomy. Furlow double-opposing Z-plasty incorporates opposing Z-shaped flaps designed to reconstruct the palatal musculature while increasing the functional length of the soft palate. Straight-line intravelar veloplasty involves direct palatal closure with muscular dissection and repositioning to restore a more physiological levator sling. Both procedures seek to improve velopharyngeal closure during speech, although their technical characteristics and the resulting anatomical configuration differ (Timbang et al., 2014).

Additional evidence concerning postoperative velopharyngeal insufficiency was provided by Xepoleas et al. (2023), who systematically reviewed 35 studies involving 10,795 patients undergoing primary palatoplasty. Among these patients, 2,186 presented signs of postoperative velopharyngeal insufficiency, corresponding to approximately 20% of the reviewed population. However, the investigators identified substantial heterogeneity in surgical terminology,

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procedural modifications, outcome definitions, and reporting practices, preventing a reliable comparative analysis of velopharyngeal insufficiency risk according to individual surgical techniques.

These methodological differences are relevant to the interpretation of Figure 2 because the percentages reported by Timbang et al. (2014) represent mean failure rates obtained from previously published investigations rather than outcomes from a single randomized comparison. Consequently, the values should not be interpreted as universally applicable probabilities for every patient undergoing either technique. Differences in cleft severity, patient selection, surgical expertise, postoperative assessment, and follow-up duration may contribute to the observed variation between studies.

Furthermore, surgical failure and postoperative velopharyngeal insufficiency are related but not entirely interchangeable outcomes. Some investigations define unfavorable results through persistent hypernasality or inadequate velopharyngeal closure, whereas others use the requirement for secondary surgical intervention. This distinction is particularly important when evaluating aggregated evidence, as differences in outcome definitions may affect reported frequencies and comparisons between techniques (Xepoleas et al., 2023).

Figure 3.

Assessment and Management of Postoperative Velopharyngeal Dysfunction

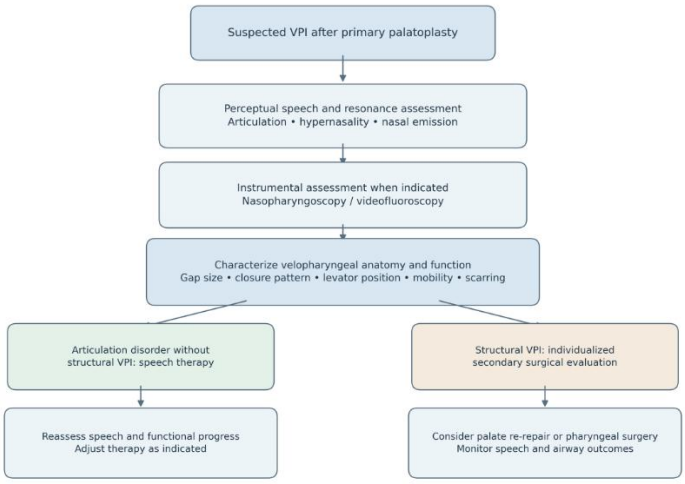


Figure 3 illustrates the principal stages involved in evaluating and managing postoperative velopharyngeal dysfunction in pediatric patients with cleft palate. The proposed clinical pathway integrates findings from systematic reviews examining secondary surgical interventions, functional speech outcomes, and anatomical factors influencing treatment selection. Unlike the preceding quantitative comparisons, this figure presents a structured synthesis of the diagnostic and therapeutic approaches reported in the literature, emphasizing the relationship between functional assessment, anatomical characterization, and individualized management (Asar et al., 2023; Kurnik et al., 2020).

The initial stage involves identifying suspected velopharyngeal insufficiency following primary palatoplasty. Persistent hypernasality, audible nasal air emission, reduced intraoral pressure during consonant production, and diminished speech intelligibility constitute important clinical findings that may indicate inadequate velopharyngeal closure. However, these manifestations require careful differentiation from compensatory articulation disorders, which may persist even when the anatomical mechanism of closure is adequate. The available literature therefore identifies perceptual speech assessment as a fundamental component of the initial evaluation, particularly when performed by professionals experienced in cleft-related communication disorders (Lindeborg et al., 2020).

The subsequent stage incorporates instrumental assessment when clinically indicated. Nasopharyngoscopy and multiview videofluoroscopy provide complementary information regarding velopharyngeal movement, anatomical

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configuration, and the characteristics of residual closure defects. These examinations allow assessment of the size of the velopharyngeal gap, closure pattern, palatal mobility, muscular positioning, and postoperative scarring. Asar et al. (2023) identified these anatomical and functional characteristics, together with patient age, as principal factors influencing the selection of secondary reconstructive procedures. Their systematic review found broadly comparable success and complication rates among the surgical approaches evaluated, supporting the need to characterize individual anatomy before selecting a treatment.

The central component of Figure 3 represents the differentiation between articulation disorders without structural velopharyngeal insufficiency and persistent dysfunction associated with an anatomical closure deficit. This distinction is essential because the two conditions involve different therapeutic targets. Children presenting primarily with learned compensatory articulation patterns may benefit from specialized speech-language intervention, whereas patients with persistent structural insufficiency generally require further assessment of potential surgical correction. Speech therapy remains important in both pathways for addressing articulation and communication outcomes, but it does not independently correct an anatomical velopharyngeal gap (Lindeborg et al., 2020; Asar et al., 2023).

For patients with structural dysfunction, the literature describes several secondary procedures, including palatal re-repair, pharyngeal flap surgery, and sphincter pharyngoplasty. Palatal re-repair focuses on improving the muscular anatomy and functional characteristics of the reconstructed palate, whereas pharyngeal procedures modify the relationship between the soft palate and pharyngeal walls. Selection depends on the anatomical and functional findings obtained during clinical assessment, including the size and configuration of the closure gap and the potential respiratory consequences of surgical intervention (Asar et al., 2023).

Quantitative evidence concerning palatal re-repair was provided by Kurnik et al. (2020), whose systematic review and meta-analysis included **18 studies** investigating secondary palatal reconstruction for velopharyngeal insufficiency. The pooled incidence of achieving no consistent hypernasality following re-repair was **61%**, with a 95% confidence interval of **44%–75%**. Additionally, the pooled incidence of requiring further surgery for persistent VPI symptoms was **21%** (95% CI, 12%–33%). These results demonstrate that functional improvement was documented in a substantial proportion of patients, although persistent symptoms and additional surgical requirements remained present in the reviewed populations.

Postoperative airway outcomes also formed an important component of the evidence. Kurnik et al. (2020) reported a pooled incidence of obstructive sleep apnea of **28%** (95% CI, 13%–49%) following palatal re-repair. The considerable variability between studies underscores the importance of interpreting these estimates in relation to differences in patient characteristics, diagnostic definitions, and follow-up practices. The review also reported substantial statistical heterogeneity across evaluated outcomes, limiting the direct generalization of pooled frequencies to individual patients.

An additional finding concerned the criteria used to select candidates for palatal re-repair. Kurnik et al. (2020) identified anterior or sagittal positioning of the palatal musculature and small velopharyngeal gaps among the commonly reported selection characteristics. Nevertheless, the analysis did not identify a specific selection criterion associated with statistically superior speech outcomes ($p = 0.6572$). This finding illustrates the limitations of relying on individual anatomical characteristics as definitive predictors of postoperative functional recovery.

The final stage of Figure 3 emphasizes postoperative reassessment following either specialized speech intervention or secondary reconstructive surgery. Relevant outcomes include changes in hypernasality, nasal air emission, articulation, intelligibility, residual velopharyngeal dysfunction, and respiratory complications. In the reviewed literature, these measures were evaluated through different clinical scales and assessment protocols, contributing to variability in the reported effectiveness of treatment (Asar et al., 2023; Kurnik et al., 2020).

Figure 4.

Longitudinal Hearing Outcomes in Children With Cleft Lip and Palate

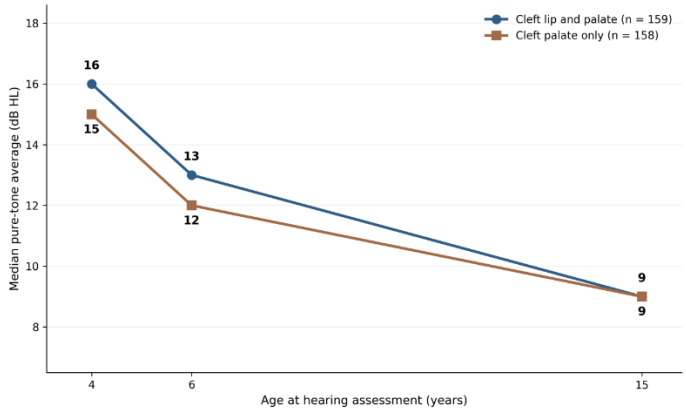


Figure 4 presents the longitudinal evolution of auditory thresholds in children with cleft lip and palate (CLP) and isolated cleft palate (CP), based on the retrospective study conducted by Skuladottir et al. (2015). The investigation included **317 children**, comprising 159 patients with nonsyndromic cleft lip and palate and 158 with nonsyndromic isolated cleft palate. Hearing outcomes were evaluated through pure-tone audiometry at 4, 6, and 15 years of age, providing information regarding auditory function across childhood and adolescence.

At 4 years of age, the median pure-tone average was **16 dB hearing level (HL)** among children with CLP and **15 dB HL** among those with isolated CP. These values represent the earliest assessment included in the figure and demonstrate a relatively small difference between the two anatomical groups. At 6 years of age, the median thresholds decreased to 13 dB HL and 12 dB HL, respectively. By 15 years of age, both groups demonstrated a median pure-tone average of 9 dB HL, indicating convergence of the reported auditory measurements during adolescence (Skuladottir et al., 2015).

The longitudinal comparison demonstrates a progressive reduction in median auditory thresholds across the evaluated ages. In patients with CLP, the median pure-tone average decreased by 7 dB HL between 4 and 15 years of age, while children with isolated CP demonstrated a reduction of 6 dB HL over the same interval. The original investigators reported statistically significant improvement with increasing age in both groups ($p \leq .001$). No statistically significant differences in overall hearing levels were identified between the two cleft categories (Skuladottir et al., 2015).

The two trajectories displayed in the figure show similar patterns, with relatively higher thresholds during early childhood and lower thresholds at the adolescent assessment. Although the numerical differences between groups were limited, the findings provide longitudinal information about hearing outcomes in children with different cleft presentations. The study also reported an association between the age of palatal closure and subsequent auditory measurements, with better pure-tone averages at 15 years among children who underwent closure at 18 months compared with those treated at 12 months. This observational finding should be distinguished from evidence obtained through randomized comparisons of surgical timing (Skuladottir et al., 2015).

The auditory findings represent one component of the broader developmental outcomes examined in the present review. Nutritional research has identified additional differences associated with cleft phenotype. In a systematic review and meta-analysis conducted in Brazil, Becker de Oliveira et al. (2024) included 29 studies and identified an association between cleft lip and/or palate and the absence of breastfeeding, reporting an odds ratio of **18.08** (95% CI, 7.09–46.09). Compared with isolated cleft lip, palatal involvement was associated with lower breastfeeding frequency (OR = 5.93; 95% CI, 4.30–8.16) and greater breastfeeding difficulties (OR = 13.55; 95% CI, 4.91–37.43). However, the certainty of evidence was classified as low or very low across the analyses.

Evidence regarding subsequent growth was less consistent. Gallego Sobrino et al. (2021) reviewed six studies assessing nutritional status and growth patterns in children between 2 and 10 years of age. Three investigations reported differences in growth between children with clefts and comparison populations, whereas the remaining three did not identify such differences. The two longitudinal studies included in that review found no significant differences in mean

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body mass index z-scores or growth curves between the evaluated groups. Greater vulnerability was reported among younger children and selected populations with additional medical or socioeconomic risk factors.

More recent evidence from Kinter et al. (2026), involving a systematic review of growth during the first 24 months of life, identified 143 eligible studies, of which 46 contained comparable anthropometric estimates. The review described lower attained growth measures relative to reference growth charts in many included populations, with weight-related deficits generally more pronounced than length-related differences. The reported estimates varied substantially across investigations and cleft phenotypes.

Although these nutritional and growth findings are not plotted on the auditory graph because they involve different measurements and populations, their inclusion provides additional descriptive information about the developmental dimensions evaluated in the reviewed literature.

Figure 5.

Multidisciplinary Follow-Up Across Developmental Stages

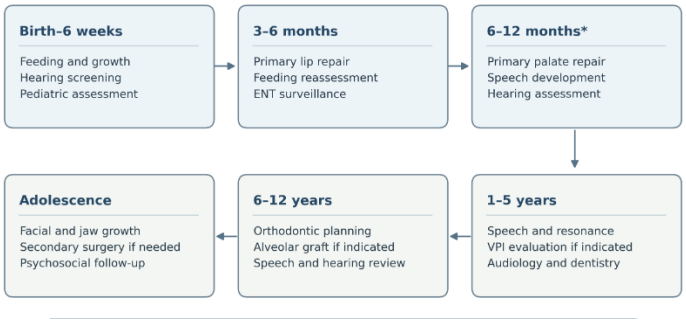


Figure 5 presents a chronological synthesis of multidisciplinary interventions associated with the management of pediatric patients with cleft lip and palate (CLP), integrating the principal surgical, functional, developmental, and psychosocial dimensions identified in the reviewed literature. The proposed framework encompasses six developmental periods, beginning with neonatal assessment and extending through adolescence. Unlike the preceding figures, which focus on individual surgical outcomes or specific functional measurements, this figure represents the organization of clinical interventions across successive stages of childhood. The sequence reflects the progressive nature of reconstructive treatment and the continuing participation of plastic surgery, pediatrics, otolaryngology, speech-language pathology, orthodontics, and other specialized services (Badiee et al., 2026; Wadde et al., 2023).

During the neonatal period, represented by the first six weeks of life, the principal components of clinical assessment include feeding evaluation, nutritional surveillance, hearing screening, and pediatric examination. Anatomical differences associated with palatal clefts may interfere with the generation of sufficient negative intraoral pressure during feeding, leading to prolonged feeding sessions and difficulties maintaining adequate nutritional intake. Published evidence has identified substantial differences in breastfeeding outcomes according to cleft phenotype. Becker de Oliveira et al. (2024) reported an association between cleft lip and/or palate and reduced breastfeeding frequency, with particularly pronounced difficulties in infants presenting palatal involvement. These findings correspond to the early nutritional assessment and caregiver-support components represented in the first stage of the figure.

The second developmental period, approximately three to six months of age, incorporates primary lip reconstruction and continued monitoring of feeding, growth, and otological status. In commonly used treatment pathways, cheiloplasty is performed during early infancy, although the operative schedule may vary according to cleft severity, associated medical conditions, nutritional status, and institutional protocols. Wadde et al. (2023) described differences among published treatment protocols, identifying considerable variation in the sequencing of reconstructive

interventions. The figure therefore presents primary lip repair as a typical intervention during this developmental period rather than as an obligatory procedure at a fixed chronological age.

The subsequent stage, approximately six to twelve months of age, focuses on primary palatal reconstruction and the initial development of speech-related functions. Evidence concerning the timing of palatoplasty was provided by Gamble et al. (2023), whose multicenter randomized trial compared repair performed at six and twelve months of age in infants with isolated nonsyndromic cleft palate. At five years of age, insufficient velopharyngeal function was documented in 8.9% of children assigned to the six-month intervention group, compared with 15.0% of those assigned to the twelve-month group. The reported risk ratio was 0.59 (95% CI, 0.36–0.99; $p = 0.04$). These findings provide quantitative context for the inclusion of palatal reconstruction within the first year of life, while the figure acknowledges that clinical pathways differ according to patient characteristics and treatment setting.

Between one and five years of age, the framework emphasizes speech and resonance assessment, audiological surveillance, dental evaluation, and identification of persistent velopharyngeal dysfunction. This developmental interval is particularly relevant because emerging speech patterns allow clinicians to evaluate resonance, articulation, nasal air emission, and speech intelligibility with increasing reliability. Lindeborg et al. (2020) highlighted the importance of speech-related outcomes in cleft palate management, while Asar et al. (2023) examined the anatomical and functional variables used to guide treatment when velopharyngeal dysfunction persists. Accordingly, the fourth stage includes assessment for secondary intervention when structural insufficiency is identified, alongside continued speech-language management.

Auditory assessment represents another component of this period. Skuladottir et al. (2015) reported longitudinal changes in hearing thresholds among children with cleft lip and palate and isolated cleft palate, with median pure-tone averages decreasing between early childhood and adolescence. Their observations provide descriptive evidence of changes in auditory measurements over time. Similarly, Téblick et al. (2019) examined the relationship between palatal closure techniques, speech outcomes, and middle-ear function, identifying the importance of assessing otological and speech-related outcomes as distinct clinical dimensions. These findings are represented in the figure through continued audiological surveillance rather than confinement of hearing evaluation to a single developmental stage.

The school-age period, approximately six to twelve years, incorporates orthodontic planning, evaluation for alveolar bone grafting when an alveolar cleft is present, and continued assessment of speech and hearing. Alveolar reconstruction is typically considered in relation to dental development and eruption patterns rather than chronological age alone. Consequently, the figure identifies this intervention as conditional upon anatomical characteristics and individual treatment requirements. Dental alignment, maxillary development, and the need for additional reconstructive procedures become increasingly relevant during this stage. Wadde et al. (2023) described variation in treatment protocols, reinforcing the distinction between broadly recognized therapeutic stages and institution-specific schedules.

Adolescence constitutes the final developmental period represented in Figure 5. During this stage, attention increasingly includes assessment of maxillofacial growth, dental occlusion, residual nasal or labial deformities, and the potential requirement for secondary reconstructive or orthognathic procedures. These evaluations occur alongside continued consideration of speech function, auditory status, and psychosocial development. The figure does not imply that secondary surgery is necessary for every adolescent with CLP; rather, it identifies procedures that may be considered when residual anatomical or functional problems persist.

Psychosocial follow-up is particularly relevant throughout later childhood and adolescence. Yusof and Mohd Ibrahim (2023) examined quality-of-life outcomes among children with cleft-related conditions, identifying physical, psychological, and social dimensions relevant to comprehensive care. Differences in facial appearance, communication difficulties, treatment experiences, and social interaction may contribute to variation in patient-reported outcomes. These findings support the representation of psychosocial care as a continuing component of the developmental framework rather than an intervention limited exclusively to adolescence.

The figure also incorporates an overarching surveillance component that extends across all developmental periods. This includes hearing assessment, speech-language evaluation, dental care, growth monitoring, and psychosocial

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support. Such continuity is consistent with the multidisciplinary approach discussed by Badiee et al. (2026), in which clinical care extends beyond isolated surgical interventions and involves coordinated evaluation of different functional systems.

Evidence from Latin America adds a geographical dimension to these observations. Rossell-Perry et al. (2021) contributed findings concerning surgical reconstruction and functional outcomes in Peru, while Araújo et al. (2022) examined speech outcomes and sociodemographic characteristics among patients receiving treatment in the Brazilian Amazon region. These investigations illustrate the relevance of regional clinical settings within the broader evidence base. Differences in healthcare access and treatment organization should therefore be considered when comparing the feasibility of longitudinal care pathways across populations.

DISCUSIÓN

The findings of this narrative review highlight the complexity of cleft lip and palate (CLP) management and demonstrate that reconstructive success cannot be adequately defined through anatomical closure alone. Across the reviewed literature, surgical timing, palatal muscle reconstruction, velopharyngeal competence, auditory function, craniofacial development, and continuity of multidisciplinary care emerge as interconnected components of long-term treatment. Although important advances have been achieved in surgical techniques and functional assessment, considerable variability persists in treatment protocols, outcome definitions, and follow-up strategies. These differences complicate direct comparisons between studies and reinforce the importance of interpreting reconstructive outcomes within the broader context of pediatric development (Badiee et al., 2026; Wadde et al., 2023).

Surgical Timing and Its Relationship With Functional Outcomes

One of the principal findings concerns the relationship between the timing of primary palatoplasty and subsequent velopharyngeal function. The TOPS randomized clinical trial demonstrated a lower incidence of velopharyngeal insufficiency at five years of age among children who underwent primary palatal repair at six months compared with those treated at twelve months. The reported incidence was 8.9% and 15.0%, respectively, corresponding to a relative risk of 0.59 (95% CI, 0.36–0.99; $p = 0.04$). These results provide important comparative evidence supporting the relevance of surgical timing in early speech-related development (Gamble et al., 2023).

Nevertheless, interpretation of these findings requires recognition of the study population and clinical setting. The TOPS trial included medically fit infants with nonsyndromic isolated cleft palate who received treatment in specialized centers across Europe and South America. Therefore, its findings cannot automatically be generalized to children with bilateral cleft lip and palate, syndromic conditions, complex airway abnormalities, or limited access to specialized perioperative care.

An additional consideration is the distinction between the primary analysis and sensitivity analyses. Although the primary comparison demonstrated statistical significance, the multiple-imputation analysis produced an estimated relative risk of 0.62 with a 95% confidence interval of 0.37–1.03, reflecting uncertainty related to missing outcome data. Consequently, the findings are consistent with a potential functional advantage of earlier palatal reconstruction, but they do not establish that a single operative age is appropriate for every clinical presentation (Gamble et al., 2023).

The systematic review by Cornefjord et al. (2023) further illustrates the complexity of defining optimal surgical sequencing. Comparisons between one-stage and two-stage palatal repair are influenced by differences in surgical protocols, anatomical characteristics, and outcome assessment. These methodological inconsistencies limit the ability to establish definitive conclusions regarding the superiority of one reconstructive sequence over another.

Collectively, these findings suggest that surgical timing should be considered a clinically relevant variable within individualized treatment planning, while recognizing that long-term functional outcomes depend on additional anatomical, technical, and developmental factors.

Reconstructive Techniques and Velopharyngeal Competence

The comparison between Furlow double-opposing Z-plasty and straight-line intravelar veloplasty represents another important finding. Timbang et al. (2014) reported lower mean failure rates following Furlow palatoplasty across the

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anatomical groups evaluated. Among patients with isolated cleft palate, the reported rates were 9.7% for Furlow reconstruction and 16.5% for straight-line intravelar veloplasty. Similar differences were observed in patients with unilateral cleft lip and palate, with corresponding rates of 11.1% and 17.1%.

These findings are consistent with the anatomical importance of restoring palatal length and reconstructing the levator veli palatini muscular sling. The functional objective of palatoplasty extends beyond separating the oral and nasal cavities; it involves reestablishing the muscular mechanisms required for coordinated velopharyngeal closure during speech. Accordingly, differences between reconstructive techniques may reflect their capacity to modify both palatal anatomy and functional mobility (Timbang et al., 2014).

However, the interpretation of technique-related outcomes must account for substantial heterogeneity. Xepoleas et al. (2023) identified important differences in operative terminology, procedural modifications, definitions of velopharyngeal insufficiency, and postoperative assessment methods. These inconsistencies restrict the reliability of pooled comparisons and complicate efforts to identify a universally superior reconstructive procedure.

Furthermore, surgical outcomes may be influenced by cleft width, tissue availability, associated anomalies, surgeon experience, and the degree of muscular disorganization. Therefore, the lower failure rates reported for one technique should not be interpreted as evidence that it will necessarily produce better outcomes in all anatomical presentations.

The broader literature supports the importance of evaluating reconstructive procedures through standardized functional measures rather than relying exclusively on technical descriptions or anatomical closure rates. This distinction is particularly relevant when determining whether postoperative hypernasality, nasal air emission, or reduced speech intelligibility reflects residual structural insufficiency, compensatory articulation, or a combination of functional abnormalities (Sainsbury et al., 2024; Lindeborg et al., 2020).

Persistent Velopharyngeal Insufficiency and Secondary Reconstruction

Persistent velopharyngeal insufficiency remains one of the principal challenges following primary palatal reconstruction. The systematic review by Xepoleas et al. (2023) identified postoperative VPI across a substantial proportion of the included populations, although the reported frequency varied according to the assessment criteria and characteristics of individual studies.

This variability demonstrates an important methodological difficulty: velopharyngeal insufficiency is not uniformly defined across the literature. Some investigations employ perceptual speech measurements, while others use instrumental findings or the requirement for secondary surgery as indicators of functional failure. These outcomes, although related, are not interchangeable.

The diagnostic pathway illustrated in Figure 3 emphasizes the distinction between structural velopharyngeal insufficiency and compensatory articulation disorders. This differentiation has direct relevance for treatment selection because speech-language therapy can address learned articulation patterns but cannot independently correct an anatomically inadequate velopharyngeal closure mechanism.

Asar et al. (2023) identified several anatomical and functional characteristics relevant to selecting secondary procedures, including closure pattern, velopharyngeal gap configuration, palatal mobility, and patient age. The available techniques include palatal re-repair, pharyngeal flap surgery, and sphincter pharyngoplasty, each involving different mechanisms of anatomical modification.

The meta-analysis by Kurnik et al. (2020) reported improvement in speech-related outcomes following palatal re-repair in a substantial proportion of patients. However, persistent symptoms, additional reconstructive requirements, and postoperative respiratory complications were also documented. These findings demonstrate that secondary reconstruction involves balancing functional improvement against the possibility of incomplete correction and procedure-related complications.

An additional concern involves respiratory function following pharyngeal procedures. Surgical modifications intended to improve velopharyngeal closure may alter upper-airway dimensions and potentially influence sleep-related

breathing. Consequently, postoperative evaluation should not be restricted to resonance and speech production but should also consider airway symptoms and respiratory outcomes when clinically indicated.

The available evidence therefore favors individualized anatomical and functional assessment rather than the application of a single secondary surgical technique to all patients with persistent VPI.

Auditory Function and Long-Term Developmental Surveillance

The auditory findings reinforce the importance of considering cleft palate as a condition with consequences extending beyond speech production. Eustachian tube dysfunction, recurrent middle-ear effusion, and conductive hearing loss represent frequent clinical concerns, particularly during early childhood when auditory input plays a fundamental role in language acquisition.

The longitudinal investigation by Skuladottir et al. (2015) demonstrated progressive improvement in median auditory thresholds between four and fifteen years of age. In children with combined cleft lip and palate, median pure-tone averages decreased from 16 dB HL at four years to 9 dB HL at fifteen years. Comparable improvement was observed among children with isolated cleft palate, whose median thresholds decreased from 15 to 9 dB HL over the same period. These findings suggest that auditory function may improve with increasing age in many patients, although the presence of favorable group averages does not exclude persistent hearing difficulties in individual children.

Importantly, improved hearing thresholds during adolescence should not be interpreted as evidence that early otological surveillance is unnecessary. Fluctuating hearing loss during sensitive periods of language development may produce functional difficulties even when subsequent measurements demonstrate improvement. Therefore, hearing outcomes must be evaluated alongside speech development, educational performance, and middle-ear health.

Téblick et al. (2019) further emphasized that palatal reconstruction and auditory recovery are not necessarily equivalent processes. Although reconstructive surgery modifies the anatomical relationships involved in Eustachian tube function, postoperative middle-ear outcomes remain variable.

These findings support a longitudinal approach in which otolaryngological assessment and audiological surveillance remain integral components of multidisciplinary treatment rather than isolated evaluations performed during the immediate postoperative period.

Nutrition, Craniofacial Growth, and Developmental Outcomes

The review also identifies important relationships between palatal anatomy, early feeding difficulties, and subsequent growth. Infants with palatal involvement may experience reduced feeding efficiency because inadequate separation between the oral and nasal cavities interferes with the generation of negative intraoral pressure. These difficulties can affect breastfeeding and nutritional intake during a period characterized by rapid physical development.

Becker de Oliveira et al. (2024) identified significant associations between cleft-related conditions and breastfeeding difficulties. Nevertheless, the authors reported low or very low certainty of evidence, indicating that the magnitude of the observed associations must be interpreted cautiously. Differences in cleft phenotype, feeding support, clinical assessment, and healthcare settings may contribute to variation between studies.

The relationship between CLP and long-term growth appears more heterogeneous. Gallego Sobrino et al. (2021) identified inconsistencies among investigations evaluating anthropometric outcomes, with some studies reporting growth differences and others showing trajectories comparable to those of unaffected children. Such discrepancies may reflect variations in nutritional support, associated congenital conditions, socioeconomic factors, and the timing of reconstructive interventions.

These findings indicate that early feeding difficulties should not be assumed to predict persistent growth impairment in every patient. However, the variability observed across studies demonstrates the need to interpret nutritional outcomes in relation to individual developmental trajectories.

Craniofacial growth introduces an additional challenge because interventions intended to restore function may interact with subsequent maxillary development. Decisions regarding alveolar bone grafting, orthodontic treatment, and

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orthognathic correction require consideration of skeletal maturation, dental eruption, and residual anatomical abnormalities.

Consequently, reconstructive planning should incorporate both immediate functional objectives and the changing anatomical requirements of childhood and adolescence.

Psychosocial Well-Being and Patient-Centered Outcomes

The psychosocial consequences of CLP constitute an essential dimension of treatment effectiveness. Children and adolescents may encounter challenges associated with facial appearance, speech differences, repeated medical interventions, and social interactions. However, psychosocial experiences vary considerably and cannot be predicted solely from cleft severity or the number of surgical procedures performed.

Yusof and Mohd Ibrahim (2023) highlighted the multidimensional nature of quality-of-life outcomes in children with CLP, including physical, emotional, and social domains. These findings are particularly relevant because conventional measures of reconstructive success frequently prioritize anatomical correction and clinician-assessed function, whereas patient and family experiences may reflect additional concerns.

The discrepancy between objective clinical measurements and perceived quality of life illustrates the limitations of evaluating treatment through isolated surgical endpoints. A satisfactory anatomical result may coexist with communication difficulties or psychosocial concerns, while patients with residual physical differences may report favorable personal adjustment.

Accordingly, patient-centered outcome assessment should incorporate age-appropriate measures of emotional well-being, social participation, communication, and satisfaction with treatment. Family perspectives are especially relevant during infancy and early childhood, whereas increasing patient autonomy should be recognized during adolescence.

Latin American Evidence and Healthcare Disparities

The inclusion of Latin American investigations contributes an important perspective to the interpretation of international evidence. Although reconstructive principles are broadly shared across healthcare systems, the availability of specialized services, geographical accessibility, economic conditions, and continuity of rehabilitation may influence observed treatment outcomes.

The study by Araújo et al. (2022), conducted in the Brazilian Amazon region, examined speech outcomes among 420 individuals with CLP. Absence of hypernasality was documented in 41% of participants, while mild, moderate, and severe hypernasality were observed in 18%, 28%, and 13%, respectively. Active speech symptoms were identified in 57% of the study population. Significant associations were reported between speech outcomes and variables including geographical origin, socioeconomic status, timing of palatoplasty, and the presence of palatal fistulas.

These findings demonstrate that anatomical and procedural factors do not fully account for differences in functional outcomes. Healthcare accessibility and the timing of specialized interventions may also influence the clinical characteristics observed in treated populations. Nevertheless, the study included individuals aged four to fifty-seven years, and its results should not be interpreted as prevalence estimates restricted to pediatric patients.

Research conducted in Peru by Rossell-Perry et al. (2021) adds evidence regarding reconstructive techniques and functional outcomes within a Latin American setting. Together, these studies demonstrate the relevance of incorporating regional clinical experience when evaluating treatment approaches developed or investigated in different healthcare systems.

However, the available regional evidence remains heterogeneous, and direct comparisons are complicated by differences in study populations, assessment methods, and treatment protocols. Additional multicenter investigations involving Latin American institutions would improve understanding of how clinical outcomes vary across healthcare environments.

Methodological Limitations and Future Research Priorities

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Several limitations must be considered when interpreting the findings of this review. First, the narrative design does not provide the exhaustive study identification, formal risk-of-bias assessment, or quantitative synthesis characteristic of a systematic review. Consequently, the findings represent a structured interpretation of selected scientific evidence rather than a comprehensive estimate of treatment effects.

Second, considerable heterogeneity exists among the included studies. Differences in cleft classification, age at intervention, surgical technique, assessment methodology, and follow-up duration restrict the comparability of outcomes. This limitation is particularly pronounced in studies evaluating postoperative velopharyngeal insufficiency, where definitions of functional failure vary.

Third, the available literature frequently emphasizes anatomical and speech-related outcomes, whereas long-term nutritional, auditory, psychological, and patient-reported outcomes are less consistently integrated into the same investigations. This fragmentation limits understanding of how different developmental dimensions interact following reconstructive treatment.

Fourth, the representation of healthcare systems with limited resources remains uneven. Although studies from Brazil and Peru contribute important regional perspectives, additional longitudinal research is needed to evaluate multidisciplinary treatment pathways across different Latin American populations.

Future investigations should prioritize standardized outcome definitions, multicenter prospective designs, and extended follow-up encompassing childhood and adolescence. Comparative research should also examine the interaction between surgical timing, reconstructive technique, functional rehabilitation, and healthcare accessibility.

Particular attention should be directed toward integrating objective clinical indicators with patient-reported outcomes and evaluating whether coordinated multidisciplinary programs improve functional development, treatment continuity, and quality of life.

CONCLUSIÓN

Cleft lip and palate represent a complex congenital condition requiring an integrated therapeutic approach that extends beyond the anatomical correction of craniofacial defects. The evidence examined in this narrative review demonstrates that successful management depends on the interaction between staged surgical reconstruction, restoration of velopharyngeal competence, and comprehensive developmental follow-up. Although contemporary reconstructive techniques have improved anatomical and functional outcomes, considerable variability persists in surgical protocols, postoperative complications, and long-term rehabilitation requirements.

The timing of primary palatoplasty emerged as an important determinant of speech-related outcomes. Evidence from the multicenter TOPS trial demonstrated a lower incidence of velopharyngeal insufficiency among children undergoing palatal repair at six months compared with those treated at twelve months. Nevertheless, these findings must be interpreted according to the characteristics of the studied population and cannot establish a universally appropriate surgical schedule. Similarly, comparative investigations suggest differences in functional outcomes between reconstructive techniques, particularly Furlow double-opposing Z-plasty and straight-line intravelar veloplasty, although methodological heterogeneity limits definitive conclusions regarding procedural superiority (Gamble et al., 2023; Timbang et al., 2014).

Persistent velopharyngeal insufficiency remains a clinically significant complication despite appropriate primary reconstruction. Its management requires accurate differentiation between structural dysfunction and compensatory articulation disorders, supported by specialized speech assessment and instrumental evaluation when indicated. Secondary reconstructive procedures may improve functional outcomes in selected patients; however, the possibility of residual symptoms, additional interventions, and respiratory complications reinforces the importance of individualized treatment planning and postoperative surveillance (Asar et al., 2023; Kurnik et al., 2020).

The reviewed evidence further demonstrates that auditory function, feeding, nutritional development, craniofacial growth, and psychosocial well-being constitute essential dimensions of long-term care. Improvements in anatomical

integrity or speech production do not necessarily correspond to equivalent progress across these domains. Consequently, multidisciplinary follow-up should incorporate coordinated participation from plastic surgery, pediatrics, otolaryngology, speech-language pathology, orthodontics, nutrition, and psychological services throughout childhood and adolescence.

The integration of international and Latin American evidence highlights the relevance of healthcare accessibility, socioeconomic circumstances, and continuity of specialized treatment. Research conducted in Brazil and Peru contributes important regional perspectives, although additional multicenter investigations are required to establish the applicability of international treatment protocols across diverse healthcare systems (Rossell-Perry et al., 2021; Araújo et al., 2022).

The principal limitations of the available evidence include variability in cleft classification, surgical techniques, functional assessment methods, and follow-up duration. Furthermore, the narrative design of this review does not permit pooled estimates of treatment effectiveness or definitive causal conclusions. Future research should prioritize prospective longitudinal studies, standardized outcome measurements, and integrated evaluation of surgical, developmental, and patient-reported outcomes.

In conclusion, optimal management of cleft lip and palate should be understood as a continuous, individualized, and multidisciplinary process in which anatomical reconstruction and functional development constitute interdependent objectives. The integration of evidence-based surgical planning, early recognition of velopharyngeal dysfunction, comprehensive developmental surveillance, and equitable access to specialized services represents a fundamental framework for improving long-term clinical outcomes and quality of life in affected children and adolescents.

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