Scholastic Dental Sciences

Review Aricle

Volume 2 Issue 1 January 2026

Orthodontic Management of Cleft Lip and Palate: Treatment Timing and Protocols An Orthodontist's Perspective -A Narrative Review

Dr. Sameer Malik,

Orthodontics and Dentofacial Orthopedics, Oxford Dental College and Hospital, Bangalore, India

Corresponding Author: Dr. Sameer Malik, Orthodontics and Dentofacial Orthopedics, Oxford Dental College and Hospital, Bangalore, India.

Received: December 31, 2025; **Published:** December 31, 2025

Abstract

Background: Cleft lip and palate (CLP) represent complex congenital craniofacial anomalies requiring long-term, multidisciplinary management. Orthodontic care plays a pivotal role throughout growth and development, influencing maxillary form, occlusal relationships, and the success of surgical interventions. This narrative review presents a chronologically structured overview of orthodontic management in patients with cleft lip and palate, emphasizing treatment timing, stage-specific objectives, and commonly employed clinical protocols. Key phases discussed include neonatal presurgical infant orthopedics, growth monitoring during the primary dentition, interceptive orthodontics and maxillary expansion during the mixed dentition, preparation for secondary alveolar bone grafting, comprehensive orthodontic treatment during adolescence, and long-term prosthetic and periodontal considerations in adulthood. The review highlights the critical importance of timing in orthodontic interventions, interdisciplinary coordination, and individualized treatment planning to optimize functional and esthetic outcomes. Advances in digital technology and virtual surgical planning are also discussed as emerging tools that may enhance precision and treatment predictability. By synthesizing current concepts and clinical practices, this review aims to provide orthodontists with a practical framework for managing patients with cleft lip and palate across all stages of development.

Keywords: Cleft lip and palate; Orthodontic management; Treatment timing; Alveolar bone grafting; Multidisciplinary care

Introduction

Cleft lip and palate (CLP) represent common congenital craniofacial anomalies worldwide and pose a complex challenge to healthcare systems due to their functional, esthetic, psychosocial, and developmental implications.[11] The management of individuals born with CLP is inherently multidisciplinary and extends from the neonatal period through adulthood, requiring coordinated interventions at carefully defined stages of growth and development.[11] While surgical repair of the lip and palate is often considered the cornerstone of cleft care, orthodontic management plays a pivotal and continuous role in influencing craniofacial growth, dental arch development, occlusal relationships, and the overall success of surgical outcomes.[11]

From an orthodontist's perspective, CLP is not a single time deformity but a dynamic growth related condition. The cleft affects maxillary development in all three planes of space, frequently resulting in transverse constriction, sagittal maxillary deficiency, vertical discrepancies, and dental anomalies such as hypodontia, supernumerary teeth, ectopic eruptions, and arch collapse.[11] These disturbances are further compounded by surgical scarring, altered muscle function, and abnormal growth patterns.[11] Consequently, orthodontic intervention is required at multiple stages, each with distinct objectives, timing considerations, and biomechanical strategies.[11]

Early orthodontic involvement often begins in the neonatal period through presurgical infant orthopedic (PSIO) procedures aimed at reducing the severity of the cleft deformity, facilitating feeding, and improving the conditions for primary surgical repair.[1–10] As the child grows, the orthodontist assumes a monitoring role during the primary dentition, followed by active interceptive treatment in the mixed dentition to correct transverse discrepancies and prepare the maxillary arch for secondary alveolar bone grafting.[11] During adolescence, comprehensive orthodontic treatment becomes essential to address malocclusion, guide eruption of permanent teeth, and determine whether orthodontic camouflage or orthognathic surgery is required to manage underlying skeletal discrepancies.[11]

The timing of orthodontic interventions in CLP patients is particularly critical, as premature or delayed treatment can adversely affect maxillary growth, compromise surgical outcomes, or increase the need for complex corrective procedures later in life.[11] Despite advances in surgical techniques and orthodontic biomechanics, considerable variability still exists in treatment protocols across cleft centers, reflecting differences in philosophy, available resources, and interpretation of evidence.[11] The purpose of this narrative review is to present a chronologically structured overview of orthodontic management in cleft lip and palate, emphasizing treatment timing, stage specific objectives, and commonly employed protocols from an orthodontist's viewpoint. By synthesizing current concepts and clinical practices, this review aims to provide clinicians with a practical framework to optimize long term functional and esthetic outcomes in patients with CLP.

Neonatal and Infant Orthodontic Care (Birth to 3 Months)

The neonatal period represents the earliest and one of the most critical phases in the orthodontic management of cleft lip and palate, as interventions initiated during this window can significantly influence subsequent surgical outcomes and craniofacial development. At birth, infants with cleft lip and/or palate often present with disrupted maxillary continuity, wide alveolar segments, nasal deformity, and compromised feeding ability. During this stage, the orthodontist's role is primarily focused on presurgical preparation, functional facilitation, and parental guidance.[2–5]

In the immediate postnatal period, the maxillary segments in cleft infants exhibit a high degree of plasticity due to the presence of maternal estrogen and increased hyaluronic acid levels in neonatal cartilage.[2] This biological responsiveness allows for gradual molding of the alveolar segments and nasal cartilages with minimal force application. Presurgical infant orthopedic (PSIO) therapy capitalizes on this window of opportunity to reduce the cleft gap, improve maxillary arch form, and align displaced alveolar segments prior to primary lip and nasal repair.[2–5] By decreasing the severity of the initial deformity, PSIO may reduce surgical tension, improve wound healing, and enhance nasolabial esthetics.[2–5] Several PSIO techniques have been described, broadly categorized into passive, active, and semi active approaches.[9–11]

Passive appliances, such as the Hotz plate, aim to provide a feeding aid while guiding spontaneous maxillary growth without the application of active forces.[9] These appliances help stabilize the tongue position, prevent collapse of the maxillary segments, and facilitate feeding, particularly in infants with complete cleft palate.[9]

Active appliances employ controlled forces through screws, springs, or elastics to approximate the alveolar segments. While effective in reducing cleft width, concerns have been raised regarding their potential impact on maxillary growth if excessive forces are applied.[11]

Nasoalveolar molding (NAM) (Figure 1) has emerged as one of the most widely adopted PSIO techniques.[2–8] NAM combines intraoral alveolar molding with extraoral nasal stents to simultaneously address alveolar and nasal deformities.When initiated within the first two weeks of life, NAM has been shown to improve nasal symmetry, elongate the columella in bilateral clefts, and achieve better alveolar alignment prior to surgery.[2–5]

Early initiation of PSIO is critical for optimal outcomes. Most protocols recommend starting therapy within the first 7–14 days after birth, once the infant is medically stable. Treatment is typically continued until the time of primary lip repair, usually around 3 to 4 months of age. Regular adjustments at weekly or biweekly intervals are required to ensure controlled molding and accommodate rapid craniofacial growth.[2–5]

Despite widespread clinical use, the long term benefits of PSIO particularly regarding maxillary growth and occlusal outcomes remain a subject of debate. Randomized controlled trials have reported mixed findings, with some studies suggesting no significant long term skeletal advantage, while others emphasize improvements in early esthetics and surgical facilitation.[8–11] From an orthodontic standpoint, PSIO should be viewed as an adjunctive, not definitive, intervention one that primarily aims to optimize early surgical conditions rather than eliminate the need for future orthodontic or surgical treatment.[11]

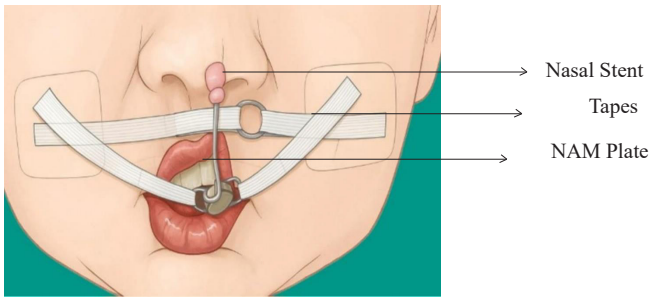

Figure 1: Depiction of nasoalveolar moulding appliance in place.

Orthodontic Considerations During the Primary Dentition Stage (0–5 Years)

The primary dentition stage represents a transitional yet critical phase in the longitudinal management of children with cleft lip and palate. Following completion of primary lip and palatal repair, the focus of care shifts from active presurgical molding to growth surveillance, functional assessment, and prevention of secondary deformities.[11]

3.1 Craniofacial and Dental Development:

Maxillary growth in children with cleft lip and palate is influenced by intrinsic growth disturbances associated with the cleft as well as extrinsic factors such as surgical scarring and altered muscular function.[11] Even in the absence of active orthodontic treatment, progressive transverse constriction of the maxillary arch is commonly observed, particularly in patients with complete cleft palate.[11] Sagittal maxillary growth restriction may also begin to manifest during this stage, although its clinical impact often becomes more evident later in the mixed dentition.[11]

The primary dentition in cleft patients frequently exhibits a range of dental anomalies, including delayed eruption, supernumeraries, ectopic positioning of primary teeth adjacent to the cleft site, enamel hypoplasia, and congenital absence of teeth most commonly the maxillary lateral incisors.[11] Anterior and posterior crossbites may develop early due to maxillary constriction and mandibular postural shifts.[11] However, routine orthodontic correction of these occlusal discrepancies is often deferred unless they result in functional impairment or progressive asymmetry.[11]

Orthodontists must therefore undertake regular clinical and radiographic evaluations to assess arch width, palatal morphology, and developing skeletal relationships.[11] Early identification of adverse growth patterns allows for timely planning of interceptive measures in subsequent stages.[11]

Orthodontic Management During Early Mixed Dentition and Pre ABG preparation (8–11Years)

The early mixed dentition period marks the first major phase of active orthodontic intervention in children with cleft lip and palate.

This stage is clinically significant because craniofacial growth becomes more predictable, permanent incisors begin to erupt, and the timing of secondary alveolar bone grafting (ABG) approaches[11,8]. Orthodontic treatment during this phase is primarily interceptive and preparatory, aimed at correcting transverse discrepancies, aligning maxillary segments, and creating an optimal anatomical environment for successful grafting[9–10].

4.1 Maxillary Transverse Deficiency and Posterior Crossbite

Transverse maxillary constriction is one of the most consistent findings in patients with cleft palate and often becomes clinically evident during the early mixed dentition[11,8]. This constriction may be a consequence of intrinsic growth deficiency, surgical scarring from palatal repair, or collapse of the maxillary segments toward the cleft site[11,5]. Posterior crossbite unilateral or bilateral is commonly observed and may be associated with functional mandibular shifts and facial asymmetry if left untreated[11,8].

Orthodontic expansion during this stage aims to restore transverse maxillary width, correct posterior crossbite, and reestablish a more favorable arch form[11,4]. Early correction of transverse discrepancies is widely supported, as it improves occlusal function and facilitates subsequent surgical procedures[6–9].

4.2 Expansion Protocols and Appliance Selection
A variety of expansion appliances are employed during the early mixed dentition, with selection guided by cleft severity, patient age, dental development, and center-specific protocols. Commonly used appliances are hyrax, fan expander, W arch, quad helix (Figure 2)[4–8].

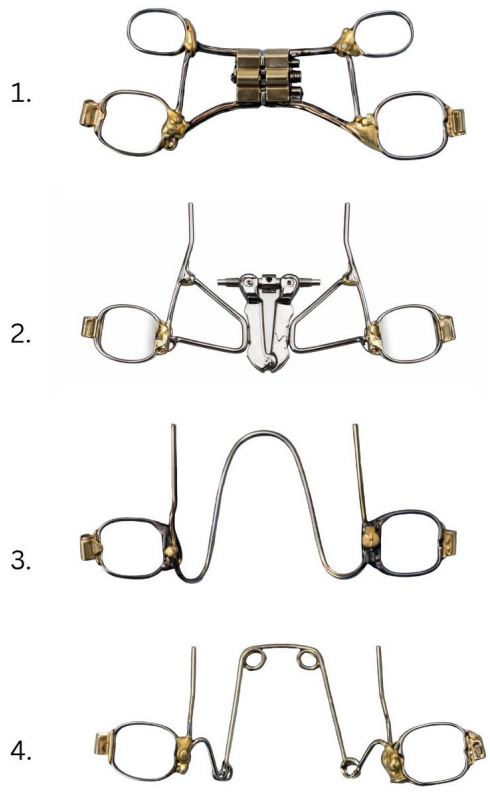

Figure 2: 1. Hyrax 2. Fan expander 3. W-arch 4. Quad helix.

- Slow maxillary expansion is commonly preferred due to its controlled force delivery and favorable tissue response. The protocol is particularly effective in patients with unilateral clefts and moderate transverse discrepancies[8–11].
- Rapid palatal expansion may be indicated in select cases with severe transverse constriction; however, its use in cleft patients requires careful consideration due to the presence of scar tissue and altered maxillary anatomy[11,9].

Regardless of the appliance used, expansion should be carried out critically, with close monitoring to avoid dental tipping, mucosal irritation, or destabilization of the cleft segments[6–8].

4.3 Preparation for Secondary Alveolar Bone Grafting

One of the principal objectives of orthodontic treatment during the early mixed dentition is preparation for secondary alveolar bone grafting. Orthodontic expansion prior to ABG serves several critical purposes: aligns maxillary segments to reduce cleft width, improves access for surgical graft placement, and enhances graft stability and integration[9–10].

In addition to transverse correction, orthodontic alignment of maxillary incisors adjacent to the cleft site may be required. Root divergence is often necessary to create sufficient space for graft placement and to prevent root damage during surgery. This, if needed, may be achieved using limited fixed appliances or removable appliances with active components[11,8].

Timing is a key determinant of success in cleft orthodontics. Expansion is typically initiated 6 to 12 months prior to planned alveolar bone grafting, allowing sufficient time for stabilization of the expanded arch before surgery[11,10]. The goal is to complete grafting when the permanent canine root is approximately one half to two thirds formed, optimizing the likelihood of canine eruption through the grafted bone[11,9]. Poorly timed expansion or incomplete orthodontic preparation may compromise graft outcomes, leading to graft resorption, inadequate bone height, or delayed eruption of adjacent teeth[11,10].

Following ABG, a period of healing and graft maturation is essential before resuming orthodontic tooth movement. This phase typically lasts 3–6 months, during which orthodontic appliances may be passive or removed to avoid mechanical stress on the grafted site[11,8]. Radiographic evaluation is necessary to assess graft integration, bone height, and continuity. Once graft consolidation is confirmed, orthodontic guidance of the erupting canine can commence. Controlled eruption through the grafted bone contributes to graft preservation and alveolar ridge development[11,9].

Orthodontists are actively involved in the long-term assessment of graft success, which includes evaluation of bone height and density within the grafted site, eruption and periodontal health of adjacent teeth, stability of the maxillary arch, and closure of residual fistulae. Radiographic indices and standardized scoring systems are often used to assess graft outcomes and guide further treatment planning[10,11]. Despite careful planning, complications such as graft resorption, inadequate bone volume, or delayed tooth eruption may occur. In such cases, orthodontic management must be modified, and re-grafting may be considered[11,9]. Early detection of complications through routine follow-up allows for timely intervention and minimizes long-term sequelae[8–10].

Orthodontic Management During the Late Mixed Dentition Stage (10–14 Years)

The late mixed dentition stage represents a consolidation phase in the orthodontic management of patients with cleft lip and palate[11,8]. Occurring

after secondary alveolar bone grafting, this period is characterized by the eruption of permanent canines and premolars, progressive establishment of occlusal relationships, and further manifestation of underlying skeletal discrepancies[10,9]. Orthodontic intervention during this stage is strategic and selective, aiming to monitor and provide Phase 1 fixed orthodontics[8,6]. Phase 1 is primarily aimed at enhancing esthetics during the late mixed dentition period, rather than addressing comprehensive functional or skeletal corrections[11,7].

At this stage, children often present with anterior dental crowding, rotations, or misaligned incisors issues that can significantly affect facial appearance and smile esthetics[9,10]. Addressing these early malalignments can improve self-confidence and social interaction during a critical period of psychosocial development[5,8]. The treatment typically involves limited fixed appliances, applied selectively to align the anterior teeth and correct minor malpositions[11,6]. Light, controlled forces are emphasized to prevent any adverse effects on teeth adjacent to the cleft site or on previously grafted alveolar bone[9,10].

In some centres, maxillary protraction is attempted at this stage, especially in situations where orthognathic surgery at a later stage is out of reach[11,8]. Orthopaedic maxillary protraction at this stage could potentially improve maxillary retrognathism but may not completely eliminate the need for orthognathic surgery later on[9,10]. Light to moderate forces are applied via elastics from the maxillary appliance to the facemask for 12–16 hours daily, usually over 6–12 months, with careful monitoring to protect the graft and control dental movements[8,11].

Orthodontic Management During Permanent Dentition and Adolescence (15–18 Years)

The permanent dentition and adolescent phase represents the most comprehensive and definitive orthodontic treatment stage in patients with cleft lip and palate[10,11]. By this time, most permanent teeth excluding third molars have erupted, and craniofacial growth is approaching completion[9,7]. Orthodontic intervention during this stage is directed toward achieving functional occlusion, optimizing facial esthetics, and determining the need for surgical correction of residual skeletal discrepancies[11,8]. This phase often integrates orthodontic treatment with orthognathic or adjunctive surgical procedures and serves as a critical determinant of long-term treatment success[6,10].

Patients with cleft lip and palate commonly present with complex malocclusions during adolescence, reflecting cumulative effects of intrinsic growth disturbances, surgical scarring, and dental anomalies[7,9]. Typical features include:

- Maxillary hypoplasia with resultant Class III skeletal and dental relationships[9,10]
- Residual transverse maxillary deficiency[7,8]
- Anterior and posterior crossbites[11,6]
- Dental crowding or spacing related to hypodontia[9,7]
- Vertical discrepancies, including anterior open bite in some cases[10,8]

These multifactorial malocclusions necessitate individualized treatment planning and careful biomechanical control[9,6]. Comprehensive orthodontic treatment using fixed appliances is usually initiated during early adolescence once sufficient dental eruption has occurred[7,10]. Treatment objectives include:

- Alignment and levelling of both dental arches[8,11]
- Correction of dental compensations[9,6]
- Coordination of arch forms[7,10]
- Establishment of stable overjet, overbite, and intercuspation[8,11]

Orthodontic mechanics in cleft patients often require customized approaches due to asymmetry, compromised periodontal support near the cleft site, and altered root morphology[9,7]. Light forces and meticulous monitoring are essential to minimize the risk of root resorption and periodontal breakdown[10,8].

6.1 Orthodontic Camouflage Versus Surgical Correction

A critical decision during this stage is whether the malocclusion can be managed through orthodontic camouflage or requires orthognathic surgery[9,11]. Mild to moderate skeletal discrepancies may be addressed through dental compensation; however, significant maxillary retrusion or severe facial disharmony typically necessitates surgical intervention[7,8]. Orthodontists must evaluate skeletal maturity, facial esthetics, functional impairment, and patient expectations when determining treatment strategy[6,10]. Clear communication with patients and families regarding treatment limitations and potential outcomes is essential[9,8].

6.2 Pre-Surgical Orthodontics and Surgical Techniques
In patients requiring orthognathic surgery, pre-surgical orthodontics aims to eliminate dental compensations and align the teeth within their respective basal bones[11,7]. This phase may temporarily worsen occlusal relationships but is essential for achieving optimal surgical correction[9,8]. Pre-surgical orthodontic preparation requires close coordination with the maxillofacial surgeon to ensure that dental positioning facilitates planned surgical movements[10,6].

The most commonly performed orthognathic procedure in cleft patients is Le Fort I maxillary advancement, which addresses sagittal and vertical maxillary deficiencies[9,11]. In cases of severe hypoplasia or extensive scarring, distraction osteogenesis may be preferred to achieve gradual advancement with improved soft tissue adaptation[8,7]. Mandibular procedures, such as sagittal split osteotomy, may be indicated in selected cases to fine-tune occlusal relationships or address asymmetry[10,6]. Surgical planning increasingly relies on digital workflows, including 3D imaging and virtual surgical simulation, which along with mockups provide 3D printed surgical splints[11,8] (Figure 3).

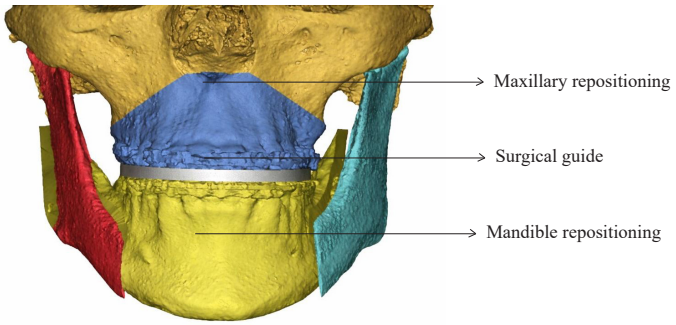

Figure 3: Depiction of Virtual Surgical Planning (VSP).

Following surgery, orthodontic treatment focuses on final occlusal settling and detailing, optimization of interarch relationships, and management of minor dental discrepancies[9,7]. Light elastics and controlled mechanics are used to refine occlusion while allowing for surgical site healing[10,8]. Close monitoring during this phase is essential to ensure stability and prevent relapse[6,11]. Relapse remains a concern in cleft patients due to factors such as surgical scarring, soft tissue tension, and altered muscle function[9,8]. Orthodontists contribute to relapse

prevention through careful finishing, appropriate retention protocols, and long-term follow-up[7,10]. Collaboration with surgeons is essential to address early signs of instability, which could be due to multiple reasons ranging from a loose surgical plate to non-union of surgical segments[11,6].

Successful orthognathic correction can significantly improve facial esthetics, speech, mastication, and airway function, thereby enhancing overall quality of life[8,9]. Orthodontists play a vital role in documenting functional outcomes and guiding patients through the transition from active treatment to long-term maintenance[10,7].

Growth Stage	Age	Key Orthodontic Interventions	Surgical Interface
Neonatal / Infant	Birth–3 months	Presurgical infant orthopedics (PSIO): passive plates, active/ semi-active appliances, nasoalveolar molding (NAM)	Primary lip and nasal repair (≈3–4 months)
Primary Dentition	0–5 years	Growth surveillance; observation; selective crossbite correction only if functional shift present	Completed lip and palate repair
Early Mixed Dentition (Pre-ABG)	8–11 years	Maxillary expansion (quad helix, W-arch, hyrax/ fan expander); limited fixed appliances for incisor alignment and root divergence	Secondary alveolar bone grafting (canine root ½–⅔ formed)
Post-ABG Phase	9–12 years	Passive appliances or cessation of active orthodontic forces for 3–6 months; guidance of canine eruption	Radiographic assessment of graft integration
Late Mixed Dentition (Phase 1 Fixed)	10–14 years	Limited fixed orthodontics for anterior alignment and esthetic improvement; light forces	Optional maxillary protraction in selected cases
Permanent Dentition / Adolescence	15–18 years	Comprehensive fixed orthodontic treatment; arch coordination and decompensation	Decision: orthodontic camouflage vs orthognathic surgery
Surgical Phase (if required)	Late adolescence	Pre- and post-surgical orthodontics	Le Fort I advancement ± distraction osteogenesis
Adult Maintenance	≥18 years	Retention; space management for prosthetic rehabilitation; periodontal monitoring	Implant or prosthetic rehabilitation

Table 1: Orthodontic Clinical Protocol for Cleft Lip and Palate.

Prosthetic Rehabilitation and periodontal health

Missing teeth, most commonly maxillary lateral incisors, are a frequent finding in adults with cleft lip and palate[7,9]. Orthodontists play a critical role in preparing and maintaining adequate space for prosthetic replacement, including dental implants, fixed partial dentures, or resin-bonded prostheses[8,10].

Implant placement in grafted alveolar bone requires careful interdisciplinary planning involving orthodontists, oral surgeons, and prosthodontists[11,7]. Radiographic evaluation of bone volume and quality is essential, and orthodontic retention must be coordinated with prosthetic timelines to ensure long-term success[9,8]. Adults with cleft lip and palate are at increased risk for periodontal complications, particularly in areas adjacent to the cleft site where bone quality and gingival architecture may be compromised[7,10]. Regular follow-up allows for early detection of relapse, prosthetic complications, or functional concerns, ensuring that treatment outcomes achieved over many years are preserved into adulthood[8,9].

Multidisciplinary Coordination in the Management of Cleft Lip and Palate

The successful management of cleft lip and palate relies fundamentally on a multidisciplinary team approach, given the complex and evolving nature of the condition[11,7]. No single specialty can address the functional, esthetic, and psychosocial challenges associated with cleft deformities in isolation. Instead, coordinated care delivered through structured cleft teams has become the standard of care, ensuring timely interventions, continuity of treatment, and optimized long-term outcomes[8,9].

A comprehensive cleft care team typically includes[7,10]:

- Orthodontists
- Plastic and reconstructive surgeons
- Oral and maxillofacial surgeons
- Pediatric dentists
- Speech and language pathologists
- Otolaryngologists
- Prosthodontists
- Pediatricians
- Clinical psychologists and cleft nurse

Each specialist contributes expertise at different stages of growth, with overlapping responsibilities that necessitate clear communication and shared treatment objectives[8,11].

Conclusion

Orthodontic management of cleft lip and palate is a prolonged, staged process that extends from infancy through adulthood and is intricately linked to craniofacial growth, surgical timing, and dental development. Unlike conventional orthodontic care, treatment in CLP patients is not confined to a single phase but involves carefully sequenced interventions tailored to evolving anatomical and functional needs.

Among the multidisciplinary team members, the orthodontist occupies a unique and continuous role throughout the patient's developmental trajectory. From neonatal presurgical orthopedics to adult retention and rehabilitation, orthodontists are involved in long term growth monitoring, occlusal guidance, and treatment planning. This continuity

places the orthodontist in a pivotal position to coordinate timing and sequencing of interventions across disciplines. Orthodontists frequently serve as the link between surgical and restorative phases, ensuring that dental and skeletal relationships are optimized before and after operative procedures such as alveolar bone grafting and orthognathic surgery.

References

1. Grayson BH, Cutting C, Wood R (1993). Preoperative columella lengthening in bilateral cleft lip and palate. *Plast Reconstr Surg* 92:1422–1423.
2. Sischo L, Broder HL, Phillips C (2015). Coping with cleft: A conceptual framework of caregiver responses to nasoalveolar molding. *Cleft Palate Craniofac J* 52:640–650.
3. Rubin MS, Clouston S, Ahmed MM, Lowe KM, Shetye PR, Broder HL, et al (2015). Assessment of presurgical clefts and predicted surgical outcome in patients treated with and without nasoalveolar molding. *J Craniofac Surg* 26:71–75.
4. Maull DJ, Grayson BH, Cutting CB, Brecht LL, Bookstein FL, Khorrambadi D, et al (1999). Long-term effects of nasoalveolar molding on three-dimensional nasal shape in unilateral clefts. *Cleft Palate Craniofac J* 36:391–397.
5. Cutting C, Grayson B, Brecht L, Santiago P, Wood R, Kwon S (1998). Presurgical columellar elongation and primary retrograde nasal reconstruction in one-stage bilateral cleft lip and nose repair. *Plast Reconstr Surg* 101:630–639.
6. Pfeifer TM, Grayson BH, Cutting CB (2002). Nasoalveolar molding and gingivoperiosteoplasty versus alveolar bone graft: An outcome analysis of costs in the treatment of unilateral cleft alveolus. *Cleft Palate Craniofac J* 39:26–29.
7. Patel PA, Rubin MS, Clouston S, Lalezaradeh F, Brecht LE, Cutting CB, et al (2015). Comparative study of early secondary nasal revisions and costs in patients with clefts treated with and without nasoalveolar molding. *J Craniofac Surg* 26:1229–1233.
8. Lee CT, Grayson BH, Cutting CB, Brecht LE, Lin WY (2004). Prepubertal midface growth in unilateral cleft lip and palate following alveolar molding and gingivoperiosteoplasty. *Cleft Palate Craniofac J* 41:375–380.
9. Santiago PE, Grayson BH, Cutting CB, Gianoutsos MP, Brecht LE, Kwon SM (1998). Reduced need for alveolar bone grafting by presurgical orthopedics and primary gingivoperiosteoplasty. *Cleft Palate Craniofac J* 35:77–80.
10. Sato Y, Grayson BH, Garfinkle JS, Barillas I, Maki K, Cutting CB (2008). Success rate of gingivoperiosteoplasty with and without secondary bone grafts compared with secondary alveolar bone grafts alone. *Plast Reconstr Surg* 121:1356–1367.
11. Ross RB (1987). Treatment variables affecting facial growth in complete unilateral cleft lip and palate. *Cleft Palate J* 24:5–77.