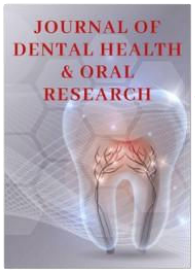

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Review Article

Orthopaeddontic Cleft Treatment: Advantages and Disadvantages

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Abstract

Early orthodontic intervention in paediatric patient with a cleft anomaly was first documented in 1956, focussing on dental and dentoalveolar-palatal transverse alignment. Since then, various institutions have adopted varying approaches to orthodontic treatment protocols. Orthopaeddontic treatment represents a progressive and structured treatment approach in paediatrics, specifically designed for young children born with oro-facial cleft anomalies, such as cleft lip-alveolus, cleft lip-alveolus-palate and an isolated hard and soft palate clefts, which includes the Pierre Robin sequence.

This advance treatment modality integrates five core elements: optimal timing during the paediatric growth spurt, a non-extraction approach, dento-orthopaeddontic intervention, an orthognathic-orthopaeddontic treatment and structured psychological support. Very specific appliances are implemented to stimulate growth in avoidance of future pre- and post-adolescent extensive orthodontic treatments and also lessen future orthognathic surgery, which is employed throughout the orthopaeddontic growth period.

The aim is to treat and deal all the different interventions, with its various advantages and disadvantages, in the young paediatric child during the age group 5 to 11 years ±1 year. These advantages and disadvantages, as an valuable approach for the maximum effect are discussed in this publication. This is in particular essential in that the standard straight, hard and direct approaches have been softened with a specific gentler approach and resorted to the help of affectionate, well-trained small animals. The detailed benefits of early treatment, as an orthopaeddontic approaches, are discussed minutely in this review publication.

Keywords: Orthopaeddontics; Cleft Treatment; Cleft Lip and Palate; Paediatric Cleft Child; Psychology; Pierre Robin Sequence

Abbreviations

C: Cleft; L: Lip; A = Alveolus; P: Palate; sP: soft Palate; hPsP: Hard+Soft Palate; U: Unilateral; B: Bilateral; PRS: Pierre Robin Sequence

Introduction

The measurement of facial proportions has been a subject of interest since antiquity, with early documentation dating back to 70 - 25 BC by Marcus Vitruvius-Pollio, a Roman engineer [1]. The classical concept of facial symmetry and proportions was later adopted and elaborated upon by Leonardo da Vinci, the Florentine Renaissance master, artist and scientist, who used the golden ratios described by Viruvius in his anatomical drawings. In the 16th century, the German artist Albrecht Dürer, further enhanced these ideas in his work "Four Books on Human Proportions" in 1528, emphasising the geometric analysis of the human face [2]. Over time, two cardinal anchors, namely facial beauty with its proportions and perfectly aligned teeth, became the standard for attractive appearance. This recognition led to the separation of specialities concerned with facial deformities. Orthodontics, focused on the dento-complex development, became as critical as the surgical intervention in managing oro-facial cleft anomalies. The psychosocial significance of facial appearance has been increasingly prominent in lectures, publications and treatments for cleft patients [3,4].

For decades, there has been a quest for the "ultimate multidisciplinary cleft treatment philosophy." A central question within this pursuit has been: how and when should early orthodontic treatment commence for a patient born with a cleft anomaly? This publication aims to introduce a novel perspective and approach to managing cleft anomalies in children. Specifically, it explores the rationale and implementation of Orthopaeddontic treatment, as a dento-orthopaeddontic intervention and an orthognathic-orthopaeddontic treatment. The objective is to demonstrate that early intervention can significantly improve long-term outcomes regarding stability, aesthetics and functional development.

Methodology

Orthopaeddontics and Additional Intervention

Orthopaeddontic treatment is a specialised interceptive treatment applied during a specific growth period of a child [5]. This treatment modality targets children aged between 5-11 years of age (± one year) and is designed to coincide with the peak periods of paediatric oro-facial growth and dental development. Within this subspecialised orthodontic treatment sequence, palatal, intermaxillary and special fixed orthodontic techniques and appliances, as previously published are utilised. Orthopaeddontic therapy is primarily indicated for patients with unilateral and bilateral cleft lip and cleft alveolus (u+bCLA) and unilateral and bilateral cleft lip, cleft alveolus and cleft palate (u+bCLAP) [5]. Additionally, children born with a Pierre Robin Sequence (PRS) present with unique anatomical challenges, including congenital mandible micrognathia that presents at birth with a typically wide hard and soft Palate cleft (hPsP) anomaly. These patients require initial neonatal/infant management with a specialised obturpaedic devices followed by comprehensive Orthopaeddontic treatment to enhance the stimulation of mandibular growth and maintain the often-compromised breathing [6].

In contrast, children born with less complex clefts, such as a standard combined hard and soft Palate cleft (hPsP) or soft Palate cleft (sP), may require a more limited Orthopaeddontic approach [7]. The relatively long treatment period in paediatric cleft patients, including those with u+bCLA and in u+bCLAP, primarily aims to achieve optimal alignment of the maxillary alveolar arch in relation to the mandibular alveolar arch. This includes efforts to avoid tooth extractions during the secondary osteofusion or osteoplasty preparation. Retaining the achieved result during the maintenance phase following surgical intervention is equally important, while accommodating ongoing variable facial growth.

Advantages

Orthopaeddontic Treatment

A fundamental principle of orthopeaddontic treatment is the expansion and positioning of the maxilla in u+bCLA and u+bCLAP patients. Due to the cleft defect, the maxilla may exhibit growth deficiencies in one or more dimensions, - transverse, sagittal or vertical (Fig. 1). When Orthopeaddontic treatment is initiated at the beginning of the designated growth period, the maxilla will respond rapidly to specific stimulation, capitalising on the naturally accelerated midfacial growth during this paediatric phase. Ideally, this expansion allows the maxilla to achieve occlusion with the mostly unflawed mandible, thereby supporting normal muscle, ligament and bone development.

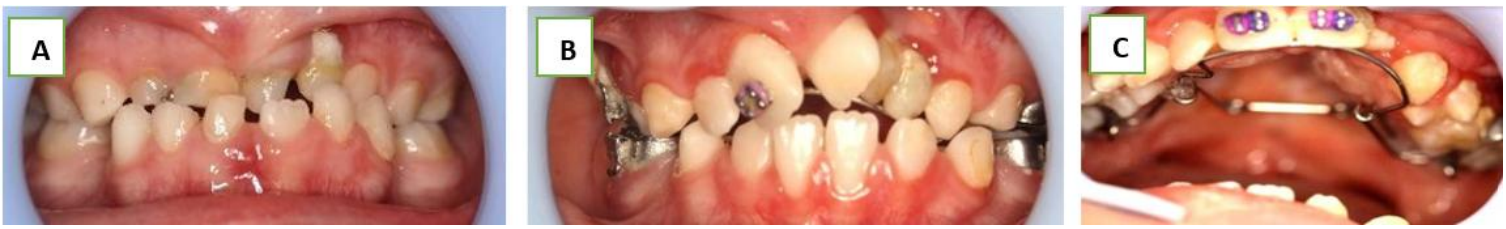

Figure 1: a: Pre-orthopaeddontic-orthognathic deformity; b,c: Progress treatments in the sagittal, vertical and transverse dimensions.

In approximately one-third of patients with hPsP cleft anomaly and a diagnosis of PRS, spontaneous mandibular growth is mostly inadequate. These cases require targeted Orthopaeddontic treatment to stimulate mandibular growth to enable occlusion with the mostly unflawed maxillary dentoalveolar arch.

During the deciduous or mixed dentition period, orthognathic facial abnormalities may naturally develop in certain cleft anomalies. These anomalies include maxillary and/or midfacial irregularities, as retrognathism (sagittal shortness) (Fig.2),

medio-lateral abnormality (transverse narrowness or collapse) and brevignathism (superior-inferior shortness). Orthopaeddontic treatment during this stage increases the likelihood of favourable positioning of unerupted permanent teeth. Early intervention reduced the complexity of aligning permanent teeth once they erupt and often eliminates the need for extractions - an outcome that significantly preserves bone. Additionally, an anterior sagittal treatment of the maxilla protects deciduous and permanent teeth from enamel chafing and abrading (Fig. 3) [8]. This provides a secondary benefit of enamel-dentine protection.

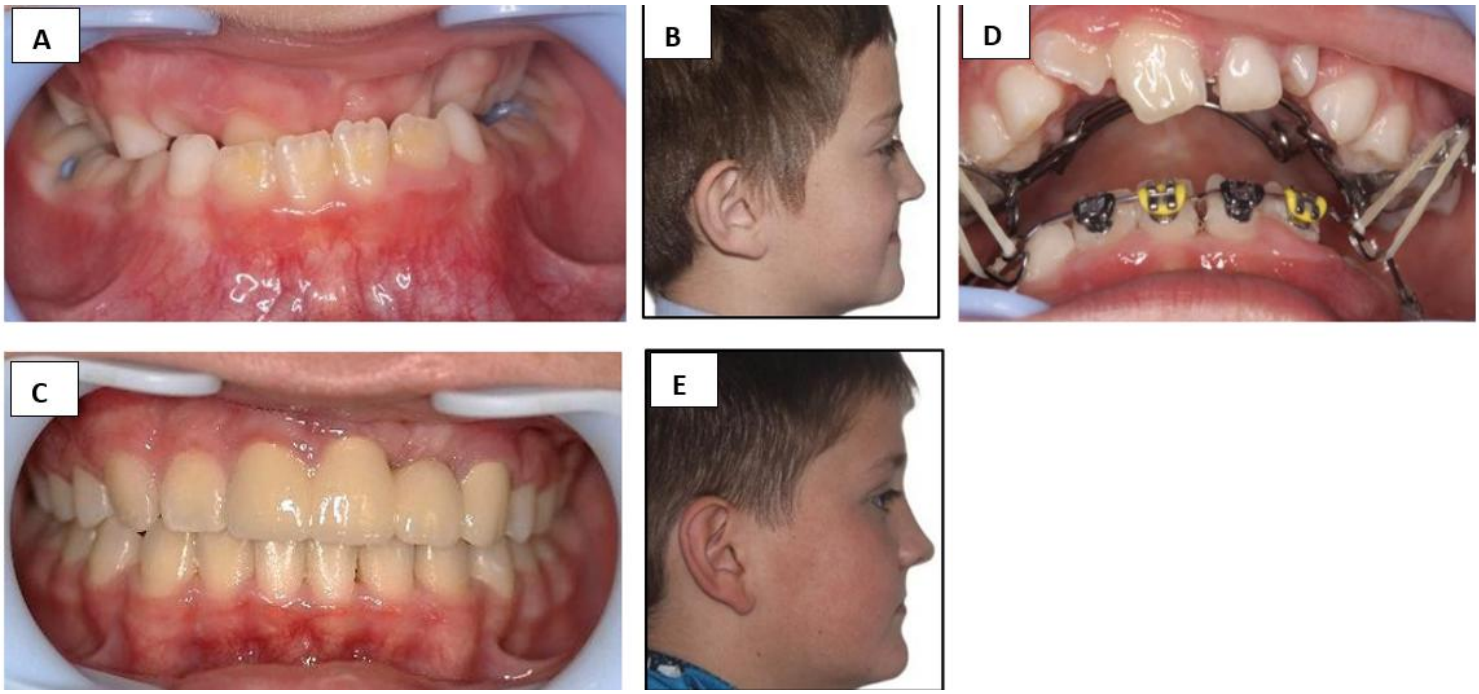

Figure 2: a: Pre-orthopaeddontic-orthognathic deformity of uCLAP; b: Lateral facial appearances; c: Intermediate orthopaeddontic treatment; d: Final orthopaeddontic and prosthodontic treatmentresults; e: Final facial appearances.

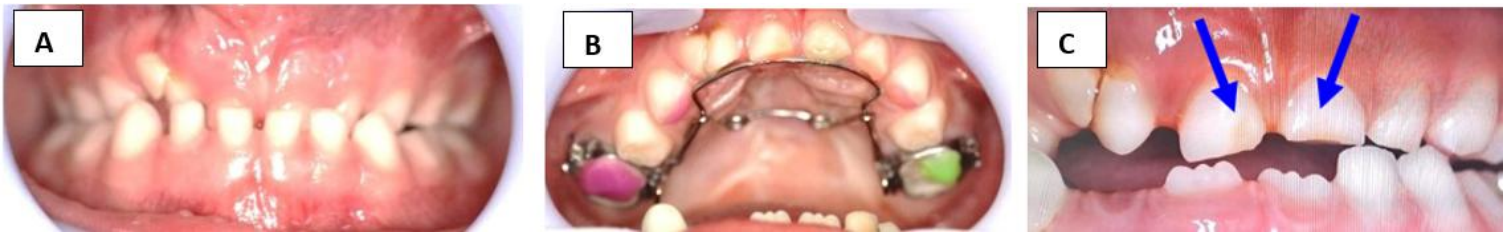

Figure 3: a: Posterior position of maxillary anterior dento-alveolar ridge; b: Modified quad-helix with anterior stoppage; c: Elimination deciduous teeth from enamel chafing and abrading (arrows).

Early correction of dentoskeletal midfacial dimensional deficiencies supports the development of a future Class I dental occlusion or a near Class I occlusion, facilitating normal musculature maturation. Dental midlines can be effectively aligned during the dento-skeletal maxillary repositioning. Once ideal maxillary-mandibular dento-alveolar arch alignment is achieved, any misaligned mandibular teeth can also be effectively repositioned. Furthermore, early orthopaeddontic intervention positively affects speech and breathing in most cleft patients.

In the long term, leveraging the critical paediatric growth window between 5 and 11 years of age allows for the correction of orthognathic midfacial deformities that, in the past, were more treated prominent during adolescent years. These deformities such as retrognathism, medio-lateral abnormalities, brevignathism or longignathism can often be prevented by implementing targeted cleft-orthopaeddontic treatment during active paediatric growth. Favourable midfacial development achieved through early intervention also positively affects the nasal and zygomatic structural bone development. Consequently, near-normal facial growth and aesthetics become possible through corrected jaw position (Fig. 2). This outcome reduces the complexity and scope of future surgical interventions.

Psychology

A gentle introduction to treatment is recommended before initiating any fixed orthopaeddontic appliance, preferably around 5 ±1 years of age. This often begins with a pre-orthopaeddontic device, such as a removable soft silicone rubber plate, placed on the lower jaw around 3½ to 4 years of age (Fig. 4). This plate serves multiple purposes: first, it protects the "bite" or occlusion in anterior crossbite cases, where cleft anomalies commonly lead to enamel shaving. Second, it introduces the very young child to the concept of oral devices, fostering a sense of responsibility and acceptance. Third, it allows the child to gradually adapt to having a device in the mouth, building familiarity and tolerance. At this stage, appliances are removable, empowering the child with control, as the device can be removed at will. This autonomy helps prevent feelings of helplessness and devastation. Fourth, with this device *in-situ* in the oral cavity, the occlusion is marginally opened as the occlusal tables are occluding onto the plate, with no enamel contact. This slight opening of the occlusion prepares the child's sensation of how a permanently cemented appliance might feel in its oral cavity.

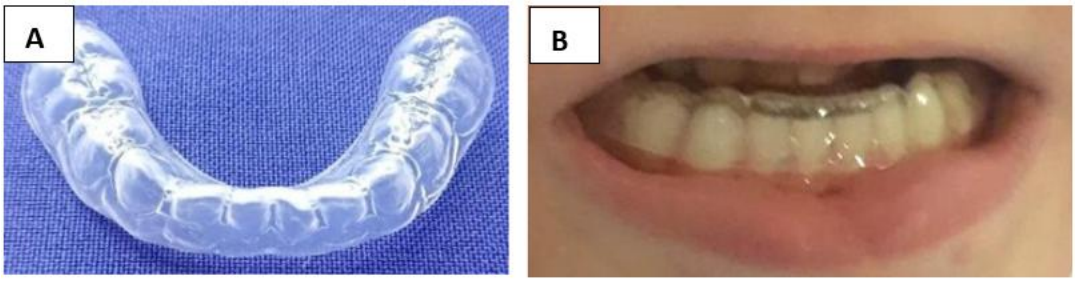

Figure 4: a: Pre-orthopaeddontic soft silicone rubber device; b: Device placed on the mandibular teeth.

New psychosocial strategies have broadened to include modalities such as animal-assisted therapy, play therapy and cognitive behavioural therapy. Studies have shown that interaction with small dogs well-trained support dogs into orthopaeddontic sessions offers emotional reassurance and distraction (Fig.5), creating a welcoming environment for the child during what would otherwise be a stressful procedure involving the placement and cementation of fixed appliances.

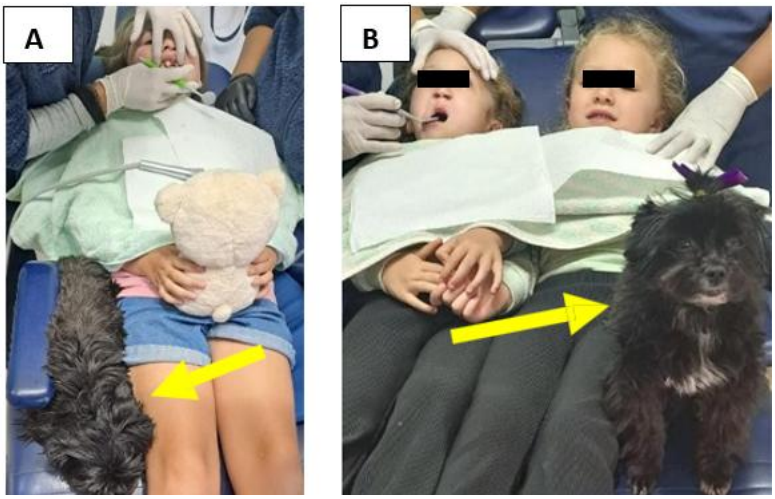

Figure 5: a: Incorporating a well-trained support dog (arrow) into orthopaeddontic sessions offers emotional reassurance and distraction; b: Dog (arrow) and sibling supporting the paediatric patient.

These dogs help establish a safe, nonjudgmental emotional space for the child, often resulting in improved cooperation and a more positive treatment experience. Parents typically respond favourably when they see that treatment is both child-friendly and emotionally supportive. Bonding with the therapy animals can even cause the child to look forward to their next orthopaeddontic visit.

For children born with cleft anomalies and their parents both often perceive the treatment journey - including surgeries and associated challenges - as traumatic and overwhelming. The inclusion of playfulness and laughter, particularly with the inclusion of therapy animals, such as small, well-trained dogs. These animals help create a comforting and positive atmosphere within the

treatment room. Throughout the orthopaeddontic treatment process, it is vital to foster a one-to-one bond, between the paediatric patient, the treating physician and the therapy dog. Consistence in care is critical; therefore, it is also essential to avoid rotating the young child between different physicians during the extended course of treatment. Maintaining continuity supports trust, emotional stability and better long-term cooperation.

Disadvantages

Orthopaeddontic Treatment

In a conventional orthodontic approach, delaying treatment until 10 to 14 years of age - or even later - often results in suboptimal outcomes for cleft patients. At that stage, correcting maxilla and/or midface deficiencies becomes significantly more difficult, particularly if teeth erupting into crowded or malposition arrangements. This is frequently observed following primary surgical correction, when untreated structural discrepancies coincide with critical phases of paediatric growth. Suppose these dimensional shortages are not addressed early in the paediatric child. If the maxillary arch is not corrected within its midfacial position, the midface and its relationship to the mandibular arch will develop into a dysgnathial discrepancy and will manifest as an orthognathic midfacial and occlusal problem. Postponing orthopeaddontic intervention beyond the ideal growth period increases the likelihood of speech deficiencies that become more evident in adolescence and potentially persist into adulthood. Resistance to early treatment may arise from parents or grandparents who perceive such intervention as premature or emotionally burdensome for the child. Additionally, treatment may be interrupted at the outset if the child strongly resists therapy and the parent chooses to discontinue it.

Compared to older children or adolescents, younger patients are more likely to experience breakages of the orthopaedic appliances. Maintaining adequate oral hygiene is also more challenging for younger children. Increased plaque accumulation and food remnants adhering to bands, brackets and appliances can lead to oral hygiene-related complications. Furthermore, the initial placement of the orthopaeddontic appliances in the oral cavity, particularly in the hard palate, may initially cause some temporary speech difficulties.

With the orthopaeddontic treatment starting at an early age, the aim is to fully utilise the critical growth period between 5-11(±1) years to correct dento-alveolar arch alignment, address orthognathic- midfacial discrepancies and realign mandibular teeth. However, the extended nature of this treatment can lead to fatigue or frustration among children and their caregivers. Parents, grandparents and patients frequently ask when all the brackets, bands and appliances will be removed. The duration of treatment depends on the severity of the cleft deformity and is, by nature, a long, complex process. This can be discouraging for families, particularly when treatment continues into adolescent years.

Psychology

The psychological challenges of orthopaeddontic treatment are markedly different for young children compared to older children or adolescents receiving extended orthodontic treatment for non-cleft issues. Emotional immaturity in younger cleft patients often results in inherent resistance to treatment, requiring significant time and patience from the clinical team. Young patients may need more time in the treatment environment to establish emotional trust and essential bonding with the physician and staff. As such, appointments often require longer or more flexible scheduling than those for older, more cooperative patients.

A secondary psychological consideration involves parental expectations. Parents may struggle with their own unresolved emotions and, in turn, promise unrealistic expectations to the child, placing unrealistic demands on the physician, such as pain-free and pleasant treatment. The orthopaeddontic devices are fixed appliances requiring follow-up every 6-8 weeks. For some families, the psychological burden is compounded by practical issues such as extended travel distance, time away from work or school and financial strain - factors that may influence compliance with ongoing treatment appointments.

Discussion

Early orthodontic intervention in very young paediatric patients with cleft anomalies may date back as early as 1939, with results of a 17-year study published in 1956 [11]. More recent studies have emphasised the importance of early orthodontic treatment in paediatric cleft patients with initial efforts focussing primarily on dental adjustment and transverse maxillary expansion [12-17]. The orthopaeddontic intervention is based on five major principles. First, treatment is optimally conducted between 5 and 11 years of age (±1year), aligning with the most active phase of paediatric growth. During this period, long-term bone growth with

oro-facial soft tissue adjustment can be positively influenced for lifelong outcomes. Second, a core principle is that this treatment follows a non-extraction approach, preserving all natural teeth, ensuring they are accommodated within the alveolar arch and securing their natural position. Third, the treatment encompasses a dento-orthopaeddontic treatment in the inter-dento-occlusion alignment between the dento-alveolar arches. Fourth, the treatment influences the incorporated orthognathic-orthopaeddontic result in three dimensions: retrognathism, medio-lateral abnormality and brevignathism [18]. The dysgnathial growth is treated through the stimulation and adjustment of the dento-alveolar and skeletal maxillary bony position or midface and mandibular bony appearances. The latter depends on the type of cleft anomaly [5,19]. Fifth, a structured psychosocial support framework is essential. Treating clinicians must guide parents in managing expectations and emotions, fostering emotional resilience in the paediatric patient.

The primary advantage of the orthopaeddontic treatment lies in maximising the exceptional paediatric growth period to establish the most favourable and normal outcomes in occlusion, speech production and midface aesthetics for patients with CLA and CLAP anomalies. Early intervention also facilitates perfect alveolar arch alignment in preparation for secondary osteoplasty or osteofusion, potentially reducing the need for long-term major orthodontics and orthognathic surgical interventions after the completed orthopaeddontic treatment period.

The psychological challenges associated with orthopaeddontic treatment should not be underestimated. In a pre-treatment phase, using a pre-orthopaeddontic device between 3 and 4 years of age can enhance cooperation and emotional readiness. Furthermore, incorporating child-friendly strategies, such as therapy animals, has been shown to improve emotional comfort, engagement and compliance during the treatment process [9,10].

However, delayed initiation or interruptions in orthopaeddontic care can reduce treatment effectiveness. The absence of early obturpaedic intervention during the infant presurgical phase may lead to suboptimal alveolar arch alignment and insufficient reduction of the lip and palatal cleft dimensions. Late initiation reduces the potential for osteo-moulding during peak paediatric growth period, increases the likelihood of needing delayed surgical intervention and raises the risk of postoperative complications. Non-ideal arch alignment and unfavourable orthognathic midfacial or mandibular positions become more probable, resulting in extended treatment timelines, requiring complex interventions and results in suboptimal outcomes in dentition, aesthetics and speech production [5].

Given the long-term benefits including midfacial growth stimulation, improved musculature function, optimal timing for alveolar bone fusion and enhanced psychosocial outcomes early Orthopaeddontic treatment should be prioritised for young children with cleft anomalies [20]. When compared to late or no treatment, early intervention is demonstrably more advantageous and is now considered a critical, standalone phase within cleft management rather than merely a subset of traditional orthodontics.

Conclusion

Early orthopaeddontic intervention in paediatric cleft patients represents a pivotal, yet often underutilised phase of comprehensive cleft care. Despite the clinical challenges associated with treating very young children, this approach provides a unique opportunity to harness critical periods of maxillofacial growth for optimal skeletal, dental and aesthetic outcomes. Contrary to the traditional belief that the orthodontic treatment should commence only after the eruption of multiple permanent teeth for fixed appliances, this study supports initiating treatment as early as 4 to 5 years of age, when growth responsiveness is the highest. The ultimate objective is to secure long-term fundamental results of an initial oro-facial cleft deformity with the most perfect positioning during growth manipulation of the midface and to establish the most ideal aesthetic facial relationship between the maxilla and mandible with a desirable aesthetic and occlusal function and consequential correction of the jaw relation and facial appearances as ideal as possible. Early orthopaeddontic treatment can significantly reduce the need for later complex orthodontic or orthognathic surgical interventions when implemented appropriately. This approach not only improves physiological outcomes but also fosters emotional resilience in young patients and their families positioning early orthopaeddontics as a critical component in modern multidisciplinary cleft management.

Conflict of Interest

The authors declare that they have no conflicts of interest with the contents of the article.

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Confirmation of Patient's or Parent's Permission
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