

Review Article

Orthopaedodontics in Cleft Treatment

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Abstract

Orthopaedodontics offers a comprehensive treatment paradigm tailored to paediatric patients aged 5 to 11 years with cleft anomalies, focussing on early correction of dento-alveolar and orthognathial deformities alongside structured psychological support. The intensive pre-surgical preparational treatment phase, conducted during this very active growth period, lays the foundation for subsequent surgical interventions, particularly secondary osteofusion, in children with the CLA and CLAP deformities. The primary objective is to achieve optimal gothic arch formation, ideal maxillary-mandibular occlusal relationship and attain balanced facial aesthetics while mitigating orthognathial deformities. Following surgery, orthopaedodontic maintenance continues into the pre-adolescent years, typically until the age of 12 years, ensuring sustained treatment efficacy before transitioning to standard orthodontic care. Central to this approach is a non-extraction treatment philosophy targeting both primary and permanent dentition, aimed at aligning teeth to achieve the most ideal arch or horse-shoe-shaped alveolus arch for all of the two (uCLA/uCLAP) or three arch segments (bCLA/bCLAP) within a balanced maxillary-mandibular occlusal relationship with an ideal facial balance. Various orthopaedodontic techniques are employed to address abnormal dimensional appearances, complimented by a psychologically sensitive approach to support paediatric patients and their families. During the orthopaedodontic treatment the treating expert needs to liaise with the parents to support the cleft child with a gentle, psychologically meaningful approach to warrant essential ultimate outcome with lifelong positive aesthetic appearance and functionality and to secure an easier acceptance of their odyssey as a person with a cleft deformity. A result of the utilization of this growth phase, related to the midfacial development

and function, needs to be comparable with the expected development of a non-cleft child at a similar age. Ultimately, successful orthopaedodontic intervention during the critical growth phase should yield marked improvements in speech, facial aesthetic and a functional occlusion, potentially reducing the need for future orthodontic treatments and minimizing treatment duration.

Keywords: Cleft; Alveolar Segmental Alignment; Premaxilla Positioning; Osteoplasty; Osteofusion; Paediatric Cleft Child; Primary Teeth; Psychology

Abbreviations

C: Cleft; L: Lip; A: Alveolus; P: Palate; SP: Soft Palate; hPsP: Hard+Soft Palate; U: Unilateral; B: Bilateral

Introduction

The field of Orthopaedodontics represents a highly specialized treatment intervention tailored for the paediatric patients born with cleft anomalies [1]. This treatment assumes particular significance during the critical growth spurt period spanning from ages 5 to 11 years, which constitutes a pivotal phase in achieving optimal outcomes for children with congenital oro-facial structures deficiencies [2]. Unlike non-cleft children who may require early orthodontic intervention, a distinctive approach is imperative in harnessing the exceptional growth potential observed in paediatric patients with cleft anomalies to ensure the most

favorable outcome by age 12 years [3]. The outcome of this treatment efficacy is then reflected in the long-term during adolescent years and adulthood, potentially necessitating fewer conventional orthodontic interventions [4,5]. Through orthopaedodontic treatment optimization, maximal attainment of ideal facial-occlusal-speech outcome, alongside the potential elimination of orthognathic deformity becomes possible [3,6].

This treatment phase commences with the correcting of the primary dentition and progresses into the mixed dentition period, often employing a non-extraction approach for both primary and permanent teeth, barring necessary extraction of supernumerary teeth adjacent or within the cleft defect. Each distinct dento-alveolar deformity, with or without concomitant orthognathic anomalies, as manifested in unilateral or bilateral cleft lip and/or palate (uCALP/uCLA, bCALP/bCLA or in hPsP/sP) anomalies, necessitates tailored and often extended obturpaedic and orthopaedodontic interventions [1,7-9]. The complexity of these treatment variations arises from the underscoring the importance of meticulous planning and consideration of the paediatric patient's psychological well-being. As paediatric patients become cognizant of their possible abnormalities, including facial appearance discrepancies, speech difficulties, and/or impaired chewing, emotional challenges for both the child and their caregivers are heightened. The traumatic experiences and perceptions following birth may give rise to various psychological and socio-cultural issues within the family dynamic which are mirrored in the child's experiences throughout the orthopaedodontic treatment period [10].

For both the child and their caregivers, the presence of CLA and CLAP anomalies presents prominent challenges, particularly lip scarring and associated congenital or eventual permanent anterior dental deficiencies or misalignment. These dental, oral and orthognathic abnormalities often lead to compromised oral function, impacting mastication, phonation and speech production.

Methods - Orthopaedodontics and Treatment

Orthopaedodontic Diagnosis and Treatment

The section provides a detailed overview of the various dimensions involved in orthopaedodontic diagnosis and treatment for children with cleft anomalies.

Appearances and Diagnosis

Medio-lateral dimension: This dimension poses a significant challenge in both u+bCLAP cases and to a lesser extent in CLA cases. Using obturpaedic techniques (FJO) in the infant has been shown to potentially achieve partial alignment of the arch and palate cleft before primary cleft reconstruction [9,11]. However, in cases where patients present with an extreme width of cleft defect, this FJO treatment may prove insufficient. Clinically, the alveolar-palatal complex plays a crucial role in mitigating the risk of permanent crossbite, often accompanied by an orthognathial under-development of midfacial structures [12].

Anterior-posterior dimension: This dimension defined by the maxillary-mandibular relationships present as part of a maxillary or mandibular dento-alveolar-orthognathic deformity. Inadequate post-obturpaedic maxillary growth may manifest as maxillary retrognathism, often attributed to under-developed or missing dento-alveolar segment(s). This deformity is commonly observed in uCLAP cases and, to a lesser extent, in u+bCLA cases. Insufficient congenital intrauterine development may lead to mandibular retrognathism in conjunction with cleft anomalies such as a hPsP or sP [9].

Superior-inferior dimension: This dimension of the midfacial structures, often visualized as a short-face or brevignathism, present very seldom as a long-face or longignathism with or without an apertognathism [9]. In the region of the anterior dento-alveolar arch or midfacial skeleton, a deficiency in superior-inferior dimension development is evident in cases of u+bCLAP and to a lesser extent in u+bCLA. Frequently, this deficiency coincides with t anterior-posterior under-development of the maxilla [13].

Micrognathism of the cleft maxilla and non-cleft mandible: In this dimension the dento-alveolar arch and/or skeletal under-development may present in the mandibular or in the maxillary region. In the midface, a significant dento-orthognathial defect is frequently observed in cases of severe lip-alveolar hard and soft palate defect (u+bCLAP). The maxillary arch segments, with the midface, often exhibit atrophy across all three dimensions, characterised by multiple congenital absent tooth follicles and a reduced number of palatal displaced maxillary teeth. This results in inadequate midfacial growth compared to the more normal

developed mandibula. In cases of mandibular micrognathia accompanied by hPsP, a presentation akin to Pierre Robin sequence may occur [1,14]. Alternatively, midfacial development may remain relatively normal despite a severe mandibular underdeveloped.

Orthopaedodontic Treatments

Treatment of the Maxillary Medio-Lateral Dimension

In cases of maxillary transverse compression and crossbite(s) resulting from dysfunctional or nonfunctional occlusion, expansion is necessary [15,16]. Most patients with uCLAP and bCLAP, present with lateral maxillary crossbite on one or both sides (Fig. 1,2).

In instances of crossbite, the oral midline of uCLAP and uCLA's is displaced to one side, necessitating comparison with the midline of the more symmetrical mandible. This asymmetrical maxillary deformity becomes apparent as soon as primary teeth erupt and is evident when the maxillary dental midline does not align with the general facial midline, observable at the philtrum, columella, nasal structure, glabella and mentum. Despite posterior arch transversal compression, bCLAP and bCLA presents with a more symmetrical appearance.

Whether a right (Fig. 1), left or bilateral crossbites, treatment involves expanding the maxillary shelves using a modified fixed appliance that bridges the palate, forcing the palatal shelves laterally [5]. Anterior support is necessary for the premaxillary segment to prevent posterior collapse during this process (Fig. 1) [2]. Flowable composite resin attachments are added to stabilize the orthopaedodontic appliance on the palatal region of the anterior primary teeth. Composite resin blocks may be placed on the occlusal surfaces of posterior teeth with prominent pre-occlusal contacts. The appliance is monitored weekly via clinical photos taken by the parent and activated every four weeks until the ideal medio-lateral arch is achieved. This initial pre-osteofusion orthopaedodontic treatment period is crucial before the eruption of permanent maxillary anterior incisors, protecting them from anterior crossbite and enamel from trauma, due to occlusal shaving and stripping. If the treatment is delayed at primary dentition stage, a similar device is anchored at the permanent first molars, however, preferably before complete eruption of permanent anterior incisors.



Figure 1: a: Medio-lateral expansion unilateral cleft; b: Medio-lateral expansion on bilateral cleft; c: Modified quad-helix with anterior stoppage.



Figure 2: a: hPsP - Maxillary crossbite - mixed dentition; b: After medio-lateral palatal expansion.

Treatment of Maxillary Anterior Deficiency

Anterior maxillary defects can be categorized as two types:

- A: The anterior segmental dento-alveolar region
- B: The total skeletal maxilla/midfacial region

Anterior crossbite often accompanies mediolateral crossbite situation [17]. Treatment involves creating an ideal arch position relative to the mandibular arch by advancing the retrognathic maxillary dento-alveolar-segmental arch. A similar appliance to the one described above is used, with separate left and right anterior extensions overlapping and positioned against the palatal surface of the premaxilla. This includes transverse expansion (Fig. 3,4) and sagittal dimensional change [5]. The appliance is anchored on primary maxillary molars and is monitored similar to the previous device.

To distract the anterior-sagittal skeletal maxilla and/or midfacial area, a labially and bracketed mandibular stabilization bar/barricade attached to the first mandibular permanent incisors is utilized, after complete eruption of this mandibular incisors. This bar/barricade is furthermore slotted posteriorly into the bands positioned at the primary molars. Traction elastics between the maxilla and mandibula are used to enhance the forward movement of the skeletal maxilla in total or the midfacial region (Fig. 3).

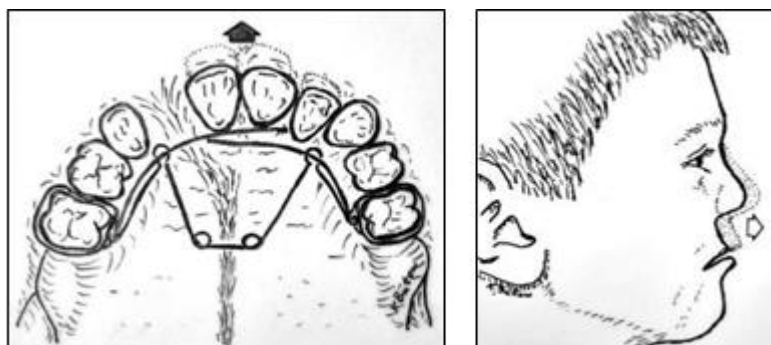


Figure 3: a: Anterior dento-alveolar segmental expansion; b: Anterior maxillary skeletal expansion for facial balance.



Figure 4: a: bCLAP - Anterior crossbite - primary teeth; b: Palatal expansion device for anterior premaxilla positioning; c: Initial result of expansion.

Treatment of the Maxillary Supero-Inferior Dimensions

Vertical deficiency can be divided into two types:

- A: The anterior segmental dento-alveolar region
- B: The total skeletal maxilla/midfacial region

Orthognathic insufficiency, such as brevignathia or a short-face is primarily observed in the anterior segmental dento-alveolar arch (Fig. 5,6) and to a lesser extent in the total maxilla and/or midfacial complex (Fig. 7) [8]. This deficiency often manifests as a deep bite. Treatment involves creating the ideal vertical position by 'opening' the occlusion using a mandibular lingual arch appliance banded and connected to the primary mandibular molars, activated with an anterior force of 150 grams. Successful results are typically achieved after a minimum treatment period of a 4 months. Contrary to popular belief, this specialized intervention is very successful during the active paediatric growth period. This maxillary appliance is used concurrently with a

maxillary medio-lateral expansion device, with additional composite resin blocks secured on molars' occlusal surface and activated every 4 weeks to maintain force control.



Figure 5: a: uCLAP - Insufficient vertical growth; b: Open mouth - cleft with mixed dentition; c: Initial result after palatal expansions a fixed appliances ready for secondary osteofusion.



Figure 6: a: uCLAP - Insufficient vertical - superior-inferior maxillary growth b: Initial result after inferior positioning of maxilla, with also palatal, anterior and medio-lateral expansion.



Figure 7: Inferior maxillary positioning for facial balance.

Treatment of the Protrusive Premaxilla (bCLAP and bCLA)

The protrusive premaxilla (bCLAP), a free-standing anterior dentoalveolar arch segment, must be moved posteriorly or posterior-superiorly. The treatment outcome is to have the premaxilla ideally located in-between, therefore mesial-distal between the left and right lateral alveolar arch segments. The premaxilla teeth should then occlude in a normal arch-occlusal relationship with the mandibular anterior teeth. A maxillary expansion force of 150-200 g over 3-6 months is used with the aid of a modified palatal expander without anterior extension wire. After transverse dimensional correction for the lateral arch segments a round arch wire is applied buccally at the bracketed primary maxilla incisors and primary molars to intrude and align the protrusive premaxilla [16]. After the alignment of the premaxilla with its anterior maxillary teeth a square arch wire needs to replace the round arch wire. Due to this orthopaedodontic treatment technique the ideal positioning of the premaxilla can be achieved (Fig. 8-10). For further precise centralization of the premaxilla, power-chain elastics and buccal hooks are used. With permanent teeth eruption this applied apparatus is transferred, step-by-step and attached at the newly erupted permanent teeth. Once the premaxilla is ideally positioned, the active device is replaced to a passive palatal one to maintain this new premaxilla position and monitored until the bilateral osteofusions surgery commences.

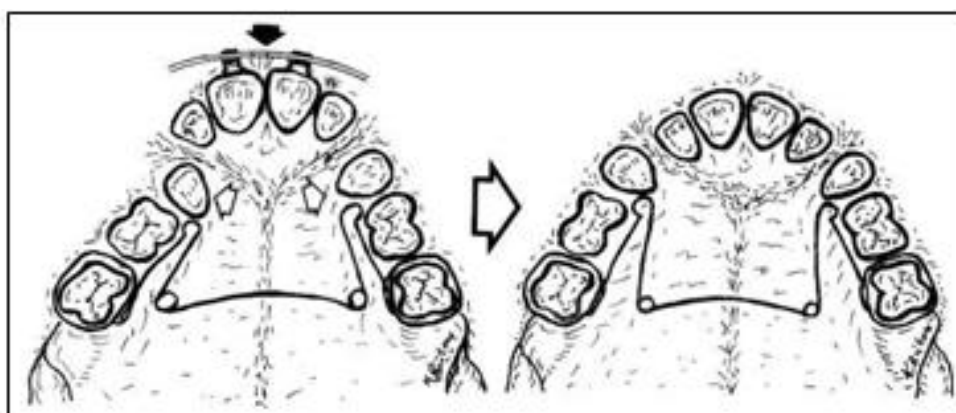


Figure 8: a: Protrusive premaxilla; b: Structuring of the gothic arch.



Figure 9: a: bCLAP - Inferiorly positioned premaxilla; b: Levelling the occlusion between premaxilla and lateral alveolar segments.



Figure 10: a: bCLAP - Protrusive - anterior and inferior positioned premaxilla; b: Medio-lateral expansion of lateral alveolar arches; c: Final position of the premaxilla before secondary osteofusion.

Treatment of the Micrognathic Maxilla and/or Micrognathic Mandible

Two types of micrognathic deficiency in a three-dimensional intervention are observed:

A: Maxillary micrognathic deformity

B: Mandibular micrognathic deformity

Micrognathic dento-alveolar-skeletal maxilla, is mainly observed in severe CLAP anomalies (Fig. 11). The orthopaedodontic treatment entails different techniques in combination for both the dento-alveolar and orthognathic structures. Achieving medio-lateral, inferior and anterior orthognathial correction with optimal dentoalveolar arch alignment is challenging [6,18]. Orthopaedodontic techniques as applied in combination are described under above-mentioned sections.

Mandibular micrognathic deformity is a combined dento-alveolar and skeletal anomaly which has developed congenitally and is mainly observed with an extensive hPsP cleft in combination with the Pierre Robin Sequence (PRS) [19]. Anterior-wards mandibular stimulation is implemented through an intermaxillary treatment device when no or insufficient mandibular catch-up growth is observed in two-third of PRS-patients [14]. The tongue expansion into a newly created oral floor space may exert medio-lateral pressure on the lateral dentoalveolar arches.



Figure 11: a: hPsP - Pre-treatment; b: Expansion of the maxilla; c: Anterior view during treatment with maxillary and mandibular brackets for maxillary inferior positioning.

Orthopaedodontic Maintained Treatment

Following the pre-surgical orthopaedodontic intervention, ideally completed around 8.5-9.5 years of age which coincides with $\pm \frac{2}{3}$ completed facial growth [3,20,21]. It is essential that the achieved result need to be obtained over the long-term. Unlike conventional orthodontic treatment based on Angle classification, orthopaedodontic care for cleft anomalies demands a more dynamic approach due to variation in dentition from left to right side [22,23]. As a continued active growth spurt is present, some of these achieved results may alter the resultant orthopaedodontic treatment. In the post-surgical healing phase, the appliances has to stay intra- orally as an inactive stabilizing scaffold for a period of six months (Fig. 12). The maintenance is therefore passive for this direct post-surgical phase to allow a non-disturbed bone graft healing at and in the alveolar cleft. Any applied active force on teeth adjacent to the alveolar segments might cause a negative result in the neo-vascularization of the transplanted bone. Therefore, abnormal forces, due to breakages of appliances, are unwanted in this crucial healing period. Active maintenance can commence soon after this healing period and if needed replacing of attachments or appliances, should a slight relapse or a more active growth spurt has occurred. The result achieved during the presurgical orthopaedodontic treatment phase, needs to be continuously observed and maintained in the long-term for a guaranteed successful occlusal outcome. Slight additional corrections may be necessary to prevent possible partial relapse and to accommodate some additional growth changes for an ultimate occlusal-facial result.



Figure 12: a: uCLAP - Anterior and lateral crossbites; b: Palatal expansion - anterior and medio-lateral with anterior positioning of maxilla, post-surgical osteofusion maintenance.

Psychological Support During Orthopaeddontic Treatment Phase

The psychological impact on parents begins with the diagnosis of an oro-facial and/or oral cleft anomaly either prenatally or at birth [24-27]. This diagnosis often initiates significant emotional distress for both parents and extended family members. Orthopaeddontic treatment typically begins around the age of five, necessitating comprehensive psychological support for parents as they prepare for their child's specialised treatment. With a well-informed background knowledge, it empowers the parent in co-operating with the multidisciplinary team during the child's extensive orthopaeddontic treatment period, with introduction to the orthopaeddontic treatment environment, treatment models and photographs of previously treated children with a similar oro-facial anomaly [27]. As such the orthopaeddontic practitioner needs to ensure the psychological support of the parent.

In addition, addressing the physical aspects of the anomaly, it is essential to provide emotional support to the child, helping it navigate feelings of anger, frustration, shyness, rejection, sadness and fear. Children with facial asymmetry, dysfunctional occlusion, compromised speech intelligibility and poor oral hygiene are particularly vulnerable to negative peer interactions. During the years of orthopaeddontic treatment the child needs to be emotionally understood and be helped in containing anger, frustration, shyness, rejection, sadness and fearfulness with all the treatment apparatus *in-situ*. This includes to be heard and specially protected against peer pressure including mocking [26]. This is in particular problematic where asymmetrical facial features, dysfunctional occlusion, insufficient oral hygiene and compromised speech intelligibility due to the treatment is present [29,30]. The changes in eating habits, due to a dysfunctional occlusion, with or without orthognathic underdevelopment, with possible oral, nasal and sinus infections, creates a more insecure patient.

The pre-orthopaeddontic phase can be used as start, with a yearly follow-up as preparation for a smoother acceptance when the orthopaeddontic treatment phase commences. As such a friendly atmosphere, an 'soft' introduction to the dental treatment room, to the dental chair and applicable apparatus, becomes more acceptable for this very young paediatric patient. Positive communication between parents and the orthopaeddontic practitioner, along with a supportive attitude towards the child's treatment plan, can significantly impact on the child's experience during treatment. Minimizing stress during dental procedures is crucial, especially for young patients who may find the dental chair and equipment intimidating. Situations such as having been placed in an uncomfortable partial lying position, could be frightening and traumatic or experiencing water-air-spray application at the oral cleft region and the spray may cause discomfort as it could echo or reverberate due to the cleft defect in the nasal and sinus cavities.

Continual psychological support should be provided by the attending doctor, as children often develop trust and rapport with a single practitioner [31]. A very young paediatric child will usually trust only one treating practitioner, therefore delegation to a temporary or rotational staff should be avoided as far as possible. It is imperative to ensure gradual realization of orthopaeddontic treatment expectations for the child, empowering them to actively participate in their own care. Collaboration between the professional treatment team, the parents and the child are absolute essential to mitigate any adverse reaction during the progress and achieve optimal treatment outcomes.

Conclusion

Orthopaeddontic treatment stands apart from standard orthodontic approaches, by leveraging the critical growth spurt occurring between the ages of 5 to 11 years, coupled with the application of special devices to address the complexities of cleft anomalies, encompassing dento-alveolar and orthognathic growth deformities. Moreover, a comprehensive psychological framework tailored to both the paediatric patient and their caregivers is essential, ensuring emotional support throughout this pivotal development phase. The orthopaeddontic treatment journey commences with primary dentition and progresses through the mixed dentition, adhering to a non-extraction treatment philosophy while addressing primary and permanent teeth, except for super-numerary teeth. Central to this approach is the correction of orofacial and facial-skeletal deformities, aiming to create orthognathic facial balance alongside aesthetic and functional improvements in the dento-alveolar arch, by fostering more natural development of facial musculature during childhood. Orthopaeddontic intervention facilitates the pursuit of balanced facial symmetry and normal appearance, circumventing growth stagnation or structural arrest. Notably, orthopaeddontic interventions stimulate midfacial skeletal and dento-alveolar growth and enhancing facial musculature in CLAP and CLA cases and mandibular growth in hPSP clefts. Ideally, optimal results manifest around 9 years of age, ideally preceding surgical alveolar

Cleft (CA) osteofusion. With sustained facial balance and post-osteofusion maintenance, the need for long-term corrective orthognathic surgical intervention(s) of the maxilla or midface or sometimes of the mandible, can often be minimised or altogether avoided.

Conflict of Interests

The authors have no conflict of interest to declare.

Line Illustrations

KW Bütow owns author rights of present and previously published line illustrations.

Language Evaluation

A.C. Wolmarans.

Confirmation of Patient's or Parent's Permission

Patient/parent's permission obtained.

References

1. Prinsloo R, Eroğlu Ç, Bütow K-W. Cleft treatment: obturpaedics, orthopaeddontics, orthodontics - important concepts. *J Dent Health Oral Res.* 2024;5:1-5.
2. Rygh P, Tindlund R. Orthopedic expansion and protraction of the maxilla in cleft palate patients - a new treatment rationale. *Cleft Palate J.* 1982;19(2):104-12.
3. Godenèche J, James I, Kraft T. How facial clefts are managed until the secondary early alveoplasty at the TREFLE clinic. *J Dentofacial Anom Orthod.* 2011;14:309-22..
4. Hameed O, Amin N, Harla P, Patel B, Hay N. Orthodontic burden of care of patients with a cleft lip and/or palate. *J Orthod.* 2019;46(1):63-7.
5. Chapman JH. Orthodontic treatment of children with clefts of the lip and the palate. *Austr Orthod J.* 1975;4(1):17-22.
6. Ricketts RM. A statement regarding early treatment. *Am J Orthod Dentofac Orthoped.* 2000;117(5):556-8.
7. Bartzela TN. Orthodontic consideration in patients with CL/P. In: *Cleft lip and palate: a variable clinical spectrum. Medical and Dental Considerations.* Dr.Habl-Charité- Berlin. 2022:12-3.
8. Bütow KW, Müller GW, De Múelenaere JJGG. Profilocephalometric analysis: a combination of the cephalophotometric and the architectural structural craniofacial analyses. *Int J Adult Orthod Orthogn Surg.* 1989;4:87-104.
9. Prinsloo R, Eroğlu Ç, Bithrey S, Bütow KW. Obturpaedics in cleft treatment. *J Dent Health Oral Res.* 2024;5:1-10.
10. Shah S. Paediatric dentistry - novel evolvement. *Ann Med Surg. (Lond).* 2018;25:21-9.
11. Maulina I, Priede D, Linkeviciene L, Akota I. The influence of early orthodontic treatment on the growth of craniofacial complex in deciduous occlusion of unilateral cleft lip and palate patients. *Stomatol Baltic Dent Maxillofac J.* 2007;9:91-6.
12. Peltomäki T, Vendittelli BL, Grayson, BH, Cutting CB, Brecht LE. Association between severity of clefting and maxillary growth in patients with unilateral cleft lip and palate treated with infant orthopedics. *Cleft Palate Cranofac J.* 2001;38(6):582-6.
13. Haas AJ. Palatal expansion: just the beginning of dentofacial orthopedics. *Am J Orthod.* 1970;57(3):219-55.
14. Bütow KW, Zwahlen RA, Morkel JA, Naidoo S. Pierre Robin sequence: subdivision, data, theories and treatment. Part III: Prevailing controversial theories related to the Pierre Robin sequence. *Ann Maxillofac Surg.* 2016;6:38-43.
15. Frank SW, Engel GA. The effects of maxillary quad-helix appliance expansion on cephalometric measurements in growing orthodontic patients. *Am J Orthod.* 1982;81:378-9.
16. Jacob AS, Kidiyoor H, Basavaraddi SM. Treatment protocols in the management of Cleft Lip and Plate (CLCP) patients - an orthodontic perspective. *J MAR Dent Sci.* 2021;3(6):1-13.
17. Rocha R, Ritter DE, Locks A, de Paula LK, Santana RM. Ideal treatment protocol for cleft lip and palate from mixed to permanent dentition. *Am J Orthod Dentofac Orthop.* 2012;141:S140-8.
18. Cozza P, Giancotti A, Petrosino A. Rapid palatal expansion in mixed dentition using a modified expander: a cephalometric investigation. *J Orthod.* 2001;28:129-34.

19. Côté A, Fanous A, Almajed A, Lacroix Y. Pierre Robin sequence: review of diagnostic and treatment challenges. *Int J Ped Otorhinolaryngol*. 2015;79:451-64.
20. Shetye PR. Orthodontic management of patients with cleft lip and palate. *APOS Trends Orthod*. 2016;6:281-6.
21. Bütow K, Zwahlen R. Cleft ultimate treatment. 2nd Ed. Reach Publishers' Services, Wandsbeck, South Africa. 2016:42-3.
22. Angle EH. Classification of malocclusion. *Dent Cosmos*. 1899;41:248-64.
23. Yadav D, Rani MS, Shailaja AM, Anand D, Sood N, Gothi R. Angle's molar classification revisited. *J Indian Orthod Soc*. 2014;48(4):382-7.
24. Abu-Hussain M, Watted N, Emodi O, Zere E. Role of pediatric dentist - orthodontic in cleft lip and cleft palate patients. *IOSR J Dent Med Sc*. 2015;14:61-8.
25. Grollemund B, Dissaux C, Gavelle P, Martinez CP, Mullaert J, Alfaiate T, et al. The impact of having a baby with cleft lip and palate on parents and on parent-baby relationship: The first French prospective multicentre study. *BMC Pediatr*. 2020;20:230.
26. Waters SF, West TW, Mendes WB. Stress contagion: physiological covariation between mothers and infants. *J Ass Psychol Sc*. 2014;25.
27. Watted A, Watted N, Abu-Hussein M. Multidisciplinary treatment in cleft lip and palate patients. *J Dent Oral Health*. 2020;2:1-12.
28. Hunt O, Burden D, Hepper P, Johnston C. The psychosocial effects of cleft lip and palate: a systematic review. *Eur J Orthod*. 2005;27:274-85.
29. Kramer FJ, Gruber R, Fialka F, Sinikovic, B, Schliephake H. Quality of life and family functioning in children with nonsyndromic orofacial cleft at preschool ages. *J Craniofac Surg*. 2008;19:580-7.
30. Frances A, Pincus HA, First MB. Diagnostic and statistical manual of mental disorders DSM-IV, 4th Ed. Publ Am Psych Ass, Washington. 1994:55-63.
31. Nahai FR, Williams JK, Burstein FD, Martin J, Thomas J. The management of cleft lip and palate for treatment and longitudinal assessment. *Seminars Plast Surg*. 2005;19:275-85.

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