Case Report

Management of an Infant with Unilateral Cleft Lip and Palate and Severe Premaxillary Rotation into the Nasal Cavity: A Case Report

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Abstract

In unilateral cleft lip and palate, defects commonly involve the upper lip, nose, and maxilla. The premaxilla, together with the columella and nasal septum, is displaced toward the normal side. The medial alveolar bone of the greater segment is also rotated superiorly. In severe cases, this displacement may result in marked premaxillary rotation and intrusion into the nasal cavity. Nasoalveolar molding has been shown to improve the surgical outcomes of the primary repair of cleft lip and palate significantly. The proper design of nasoalveolar molding will help achieve favorable treatment outcomes in most cases. A 4-day-old Thai male infant presented with a complete left unilateral cleft lip and an incomplete cleft palate, together with severe rotation of the premaxilla into the nasal cavity. Before initiating nasoalveolar molding, the patient had worn an obturator for 1 month. Nasoalveolar molding with an expansion screw was introduced as part of the management to address the premaxillary rotation and alveolar collapse. The appliance was designed to expand the medially collapsed left lateral alveolar ridge, facilitate alignment of the premaxilla, and improve nasal symmetry before surgical intervention, thereby establishing a more favorable maxillary arch relationship. Appliance stability was achieved using an extraoral retention strap in combination with denture adhesive, allowing consistent appliance wear and effective molding of both nasal and alveolar structures. The patient subsequently underwent cheiloplasty at 10 months of age and palatoplasty at 1 year of age in accordance with the treatment plan. At the 18-month postoperative follow-up, the patient showed excellent wound healing, increased nasal projection, and symmetrical lip alignment. This case highlights the effectiveness of nasoalveolar molding with an expansion screw in facilitating presurgical alignment of the premaxilla and enhancing nasal symmetry, thereby contributing to favorable overall outcomes when combined with definitive surgical repair.

Keyword: Expansion screw, Nasal clip, Nasoalveolar molding, Severe premaxilla rotation, Unilateral cleft lip and palate

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Introduction

Cleft lip and palate (CLP) is one of the most common congenital anomalies of the craniofacial region, presenting as a complex deformity that disrupts the continuity of the lip, alveolus, and palate. CLP also causes nasal deformities, such as tip deviation and asymmetry, which may require surgical correction. These changes result in functional and esthetic challenges. The extent of alveolar displacement and premaxillary rotation varies among individuals, influencing the severity of the deformity and the complexity of surgical correction.

In complete unilateral CLP, the alveolar ridge is divided into greater and lesser segments, whose spatial relationship is critical for both presurgical orthopedic management and surgical planning. Unilateral cleft alveolar arches are classified into four morphological patterns according to gap width (wide or narrow) and the presence or absence of segment collapse.[1] Severe deformities, such as marked premaxillary rotation or nasal displacement, alter the maxillary arch form and widen the alveolar gap. These alterations lead to anterior dental malalignment, including crossbite, Class III malocclusion, and eruption irregularities, which predispose patients to malocclusion and complicate future orthodontic or bone grafting procedures.[2] The resulting imbalance also interferes with lip closure and may contribute to asymmetric nasal growth.[3] Management becomes particularly demanding in cases with wide gaps, posteriorly and medially displaced lesser segments, or severely rotated premaxillae, as precise appliance activation and control are required to prevent segment locking and soft-tissue tension.

Nasoalveolar molding (NAM), introduced by Grayson *et al.* in 1993, combines an intraoral molding plate with a nasal stent. The molding plate repositions the alveolar segments and premaxilla, while the nasal stent applies gentle and continuous pressure to the neonatal cartilage, enhancing nasal symmetry.[4] This technique utilizes the plasticity of neonatal cartilage in the first 4-6 weeks of life, influenced by maternal estrogen and hyaluronic acid.[5] In severe cases with premaxillary rotation or space deficiency, an expansion screw can widen the alveolar ridges and provide sufficient space for premaxillary alignment. The use of an extraoral strap and denture adhesive provides stabilization, ensuring consistent orthopedic forces and appliance retention throughout the molding process.

An expansion screw is an adjunct that can be incorporated into nasoalveolar molding to facilitate separation and transverse expansion of the alveolar segments. This approach may achieve a greater amount of alveolar expansion than guidance with nasoalveolar molding alone. Gradual, incremental screw activation enables the desired increase in arch width and allows the clinician to control the magnitude of expansion based on the amount of activation applied. This expansion can help release segmental interlocking and create sufficient space to facilitate premaxillary alignment, particularly in severe cases with premaxillary rotation and space deficiency.

Surgical correction is achieved with cheiloplasty to restore lip and nasal form, and palatoplasty for palate closure and to separate the oral and nasal cavities, improving both feeding and speech. Postoperative nasal molding, such as nasal clip and Nasoform, is employed to maintain the surgical results and guide nasal growth during infancy and early childhood.[6-8]

This case report presents the comprehensive management of a complete left unilateral cleft lip and incomplete cleft palate infant with a severely rotated premaxilla and collapsed alveolar ridges. Presurgical nasoalveolar molding with an expansion screw was used to reposition the premaxilla, create sufficient space for premaxillary alignment, and improve nasal symmetry. Subsequent lip and palate repair achieved favorable functional and esthetic outcomes. The findings highlight the importance of presurgical nasoalveolar molding and coordinated multidisciplinary care in managing complex cleft deformities.

Case report

General history and examination

A 4-day-old Thai male was referred to the Center of Excellence in Correction and Rehabilitation of Dentofacial Deformities at the Faculty of Dentistry, Prince of Songkla University (CCDD). The cleft was classified using the system of Kernahan and Stark for communication and description in this report.[9] The patient was categorized as having a complete left unilateral cleft lip and incomplete cleft palate. For detailed mapping, by using Friedman modification[10], the cleft involved block number 6–12 and 15, including the left nostril arch, nasal floor, lip, alveolus, anterior palate up to the incisive foramen, hard palate beyond the incisive foramen, soft palate, and prolabium (Fig. 1a). The diagram codes were defined as follows: Box 6, No. 4 indicates severe deformity of the left nostril arch; Box 7, No. 4 indicates severe deformity of the left nasal floor; Box 8, No. 4 indicates a complete cleft of the left upper lip; Box 9, No. 3 indicates a complete cleft of the left alveolus; Box 10, No. 2 indicates a complete cleft of the left pre-incisive trigone; Box 11, No. 3 indicates a posterior two-thirds cleft of the hard palate; Box 12, No. 5 indicates a complete cleft of the soft palate; and No. 0 indicates no protrusion or no involvement of that area. In the hard palate region, a segment of palatal tissue remained intact, consistent with a submucous cleft. The cleft was confined to the anterior hard palate and the soft palate (Fig. 1b). The tip of the nose was deviated to the right side (Fig. 1c). No serious medical illness was recorded. The anterior part of the greater segment (A-GS) was severely rotated into the nasal cavity. The lesser segment (LS) was medially collapsed toward the palatal side of the greater segment (GS) (Fig. 1c). Insufficient space for proper alignment of the maxillary segments was noted. Neonatal tooth was found at A-GS (Fig. 1d) and was removed before starting treatment with the NAM appliance (Fig. 1e).

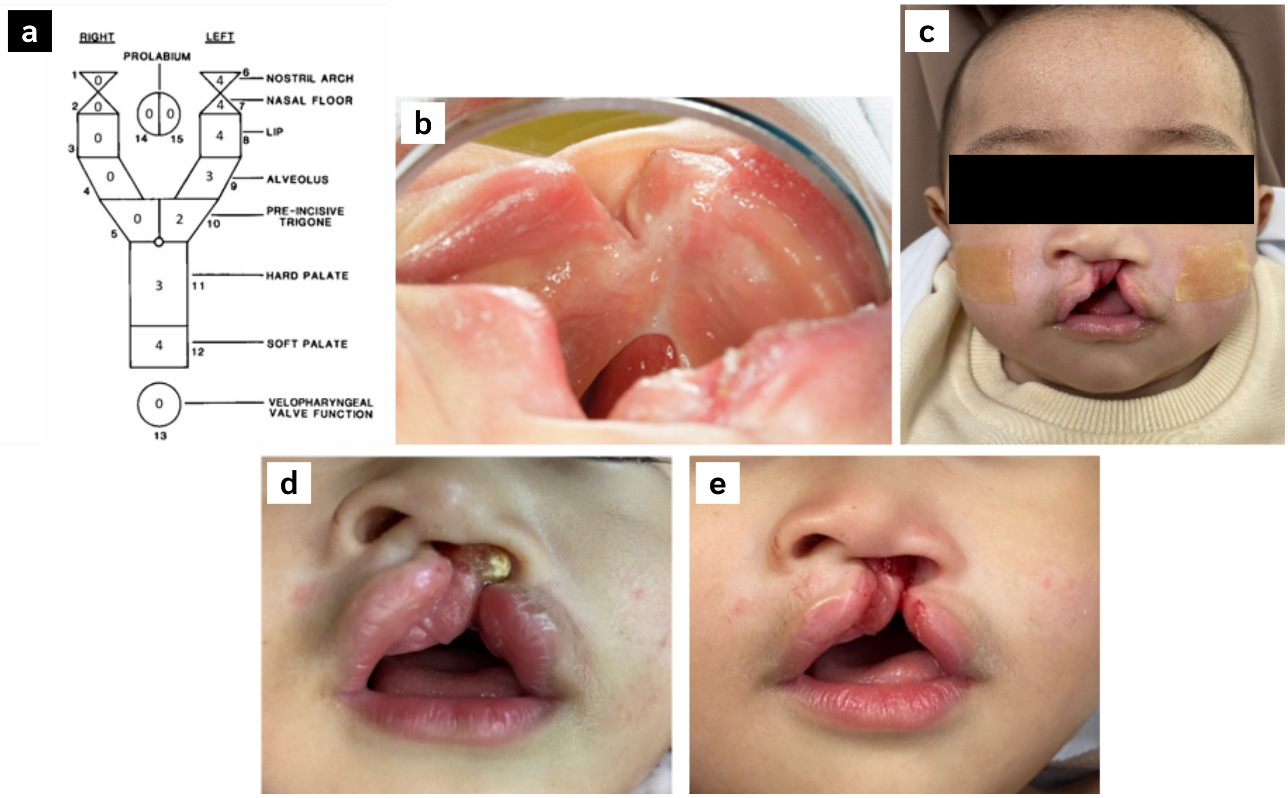

Figure 1 *Pre-treatment: (a) Friedman modification; (b) intraoral examination; (c) extraoral examination; (d) before extraction of neonatal tooth at the premaxilla; and (e) after extraction of neonatal tooth at the premaxilla*

Nasoalveolar molding appliance fabrication method and appliance design

A nasoalveolar molding with an expansion screw was used to create sufficient space for aligning the A-GS into a more appropriate position (Fig. 2a).

The appliance was fabricated on the working model. The A-GS on the model was sectioned and rotated downward and palatally by approximately 2 mm into the new position (Fig. 2b). The screw (Fig. 2a) was activated twice daily, with a quarter-turn in the morning and a quarter-turn in the evening, as instructed. In the initial phase, a nasal stent could not be used because the A-GS had rotated into the nasal cavity, resulting in insufficient space for the appliance. Therefore, an extraoral strap was used to pull the separated lip into a more appropriate position.

After the A-GS was in a more suitable position and there was sufficient space within the nasal cavity, a nasal stent was added to the appliance. The nasal stent was made of stainless-steel wire with an acrylic bulb at the terminal end (nasal bulb). The wire was extended into the left nostril, gently elevating the depressed alar cartilage. Denture adhesive was applied to stabilize the appliance and maintain the premaxilla in the designed position. During the use of this appliance, approximation of the separated lip was maintained by an extraoral strap (Fig. 2c).

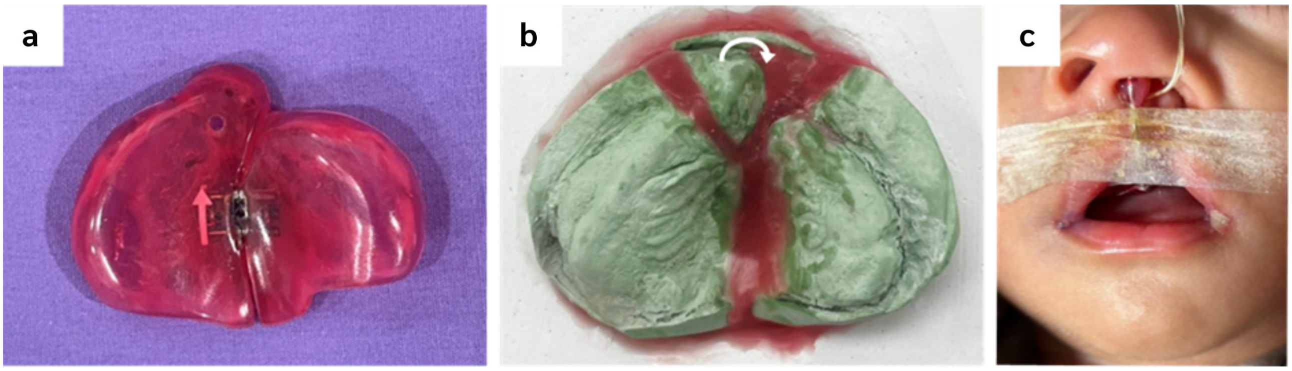

Figure 2 *Nasoalveolar molding appliance design: (a) nasoalveolar molding appliance; (b) working model with new position of alveolar ridge; and (c) appliance with extraoral strap*

Treatment outcome and retention

After 10 months of nasoalveolar molding treatment using six appliances sequentially, the duration of use for each appliance varied. During treatment, a new appliance was fabricated whenever a design modification was required, such as adding a nasal stent to the second appliance after 1 month of obturator use, replacing the appliance when erupting teeth interfered with insertion/wear, or fabricating a new appliance following minor procedures such as frenectomy. The patient was instructed to wear the appliance full-time, removing it only for hygiene care. Appliance cleaning was performed using a soft-bristled toothbrush and liquid soap. Follow-up visits were scheduled monthly throughout treatment. Parental compliance was good. The caregivers consistently inserted the appliance appropriately, maintained the recommended full-time wear schedule, performed adequate appliance hygiene, and attended follow-up visits regularly. No complications were observed during treatment. Clinically, the premaxilla moved downward and palatally by approximately 2 mm; its rotation decreased and its alignment improved. The lesser segment moved laterally by approximately 4 mm. At this stage, the patient was referred for cheiloplasty (Fig. 4).

The patient underwent cheiloplasty by rotational advancement technique and palatoplasty by two-flap palatoplasty techniques at the ages of 10 months and 1 year, respectively. A nasal clip was then applied to further maintain and improve the nasal cavity.

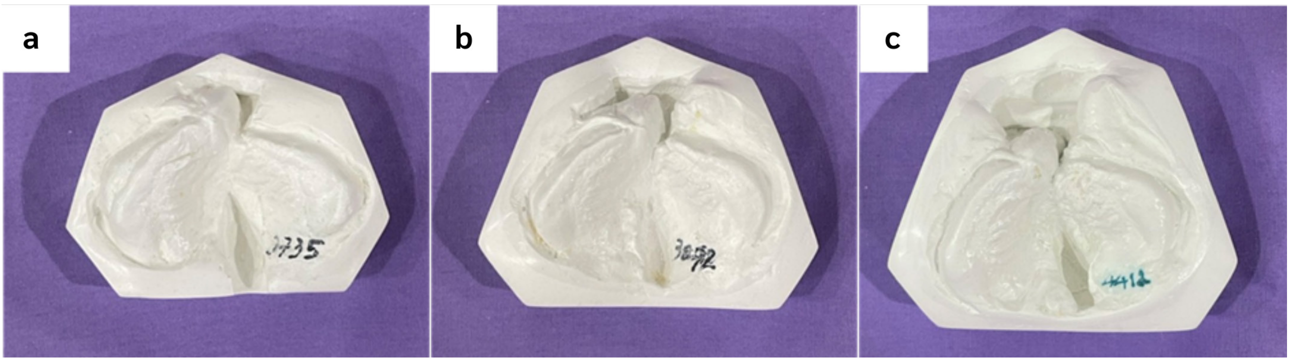

Figure 3 *Intraoral model: (a) pre-treatment; (b) after 3 months of nasoalveolar molding treatment; and (c) after 10 months of nasoalveolar molding treatment*

Figure 4 *Intraoral examination after 10 months of nasoalveolar molding treatment*

After one month of cheiloplasty follow-up, the lip and nose demonstrated normal wound healing and showed noticeable improvement. The nasal bridge became straighter, nasal tip deviation decreased, and lip symmetry was markedly enhanced with good mobility (Fig. 5a and 5b). A PSU nasal clip (Fig. 5c) was applied to maintain the surgical result and appropriately guide nasal growth (Fig. 5d). This was intended to prevent postoperative scar contracture, which could restrict tissue movement and adversely affect subsequent facial growth.[11]

After 14 months of palatoplasty, the nose and lip showed very favorable outcomes, and all primary teeth exhibited normal eruption except the rotated left primary maxillary central incisor and the left primary maxillary lateral incisor, which erupted in the cleft space (Fig. 6a and 6b).

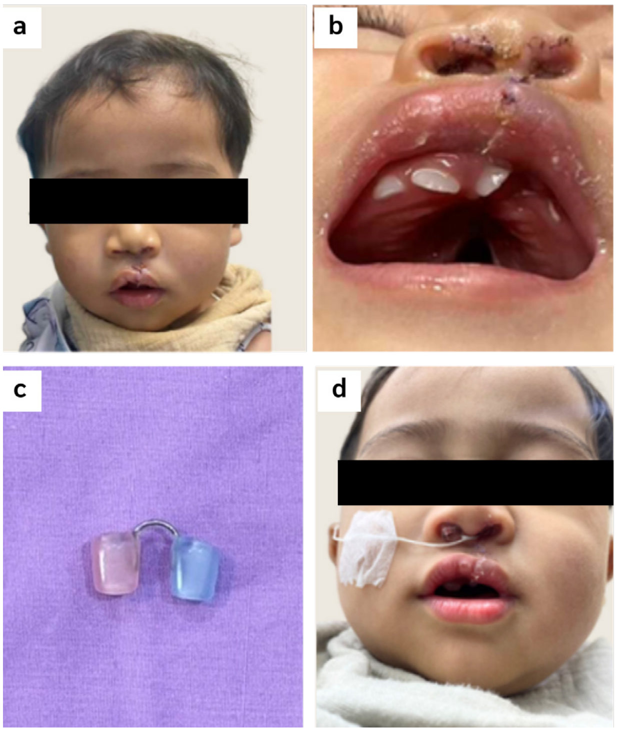

Figure 5 *After cheiloplasty: (a) extraoral examination at 1-month follow-up; (b) intraoral examination at 1-month follow-up; (c) PSU nasal clip; and (d) extraoral examination at 1.5-month follow-up with the PSU nasal clip applied*

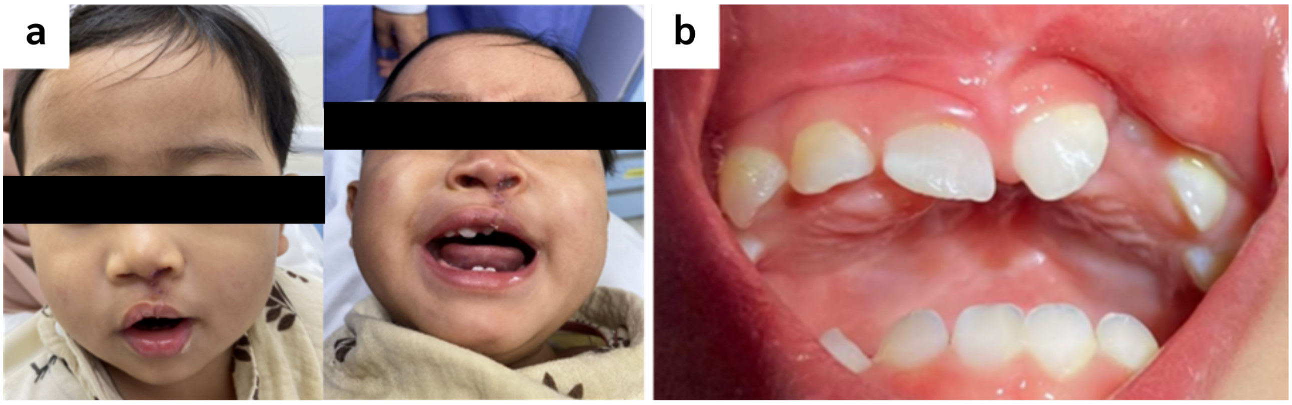

Figure 6 *Post-treatment at the age of 1.6 year: (a) extraoral examination; and (b) intraoral examination*

Discussion

Management of the CLP requires a multidisciplinary approach starting shortly after birth and continuing throughout the child's growth. The primary goals are to restore feeding function, improve facial aesthetics, and facilitate normal speech development. Presurgical orthopedic treatment in newborn cleft patient, such as nasoalveolar molding, is an integral component of cleft care, aiming to reduce the severity of the deformity and optimize surgical outcomes.[5]

In this case, nasoalveolar molding was initiated during the neonatal period to realign the anterior part of the greater segment and improve the nasal deformity. An expansion screw gradually expanded and provided controlled widening of the alveolar ridge, creating adequate space for premaxilla repositioning. This technique allowed the premaxilla to move into a more favorable position while simultaneously reducing soft tissue tension before primary lip repair. These findings are consistent with reports by Tyler *et al.* (2023), who demonstrated that alveolar expansion using a screw-based nasoalveolar molding appliance effectively improves segment alignment and decreases surgical difficulty.[12]

The incorporation of a nasal stent was a key component of this treatment. By applying continuous and gentle pressure, the stent reshaped the neonatal nasal cartilage. During the first weeks of life, neonatal cartilage is highly malleable due to its increased hyaluronic acid content and responsiveness to maternal estrogen. This enhanced plasticity allows the cartilage to deform and adapt gradually under the sustained pressure of the stent, enabling effective reshaping of the cleft-related nasal structures. This intervention improved symmetry of the nasal tip and alar base on the cleft side, correcting the initial deviation of the nasal tip and bridge toward the right. Similar improvements in nasal morphology, along with a reduced need for secondary rhinoplasty, have been reported in previous studies.[5, 13, 14]

Although NAM is typically initiated from birth to around 3-4 months of age because neonatal nasal cartilage is highly malleable due to the influence of estrogen and increased hyaluronic acid levels, this case required a treatment duration extending beyond this period. In our patient, the appliance continued to guide growth beyond the initial cartilage molding phase by maintaining the nasoalveolar structures in an appropriate position and providing ongoing support. Overall, the treatment outcome was satisfactory.

Orthodontic preparation for cheiloplasty in a late-treatment group may differ from that in newborn CLP patients. In the present case, cheiloplasty was performed later than usual because a relatively extensive degree of presurgical correction was required to adequately prepare the tissues and segments for lip repair. Consequently, multiple appliances were needed during the course of treatment; in this patient, a total of six appliances were used. In addition, when cheiloplasty is delayed and the patient becomes older, the child's cooperation with appliance wear may decrease, thereby necessitating a higher level of parental compliance to ensure consistent use and adequate hygiene.

An extraoral strap was also used to stabilize the nasoalveolar molding appliance and promote optimal tissue adaptation. This modification ensured consistent control of the premaxilla and minimized appliance dislodgement, which is especially important in infants with highly mobile oral tissues. Additional minor procedures were performed during treatment to facilitate appliance fit and function, including extraction of a neonatal tooth that interfered with the appliance. In addition, denture adhesive was applied as an adjunct to further enhance retention and stability of the appliance, facilitating prolonged and consistent wear and encouraging continuous movement of the alveolar ridge. Proper oral hygiene and thorough cleaning of the appliance after each use were emphasized to prevent irritation or microbial accumulation. In general, disadvantages and potential adverse effects of this appliance include loosening and the possibility of soft-tissue pressure or irritation within the oral cavity. In addition, successful treatment requires a high level of caregiver compliance, particularly regarding full-time wear and meticulous appliance hygiene. In the present patient, the only issue encountered was that the appliance tended to become loose and dislodged easily. This was effectively managed by using a denture adhesive, which improved retention; however, it required increased attention to cleaning and oral hygiene. This appliance is commonly used in cleft lip and palate patients when structural modification of the nasal complex and maxilla is indicated.

It is typically considered in cases involving an excessively wide or narrow cleft gap, a protrusive premaxilla, or significant nasal deviation. Nevertheless, it is not used routinely for every CLP case and should be reserved for appropriately selected patients.

After 10 months of treatment, the premaxilla had nearly achieved a normal position with a significant reduction in rotation, and nasal symmetry was markedly improved. This facilitated cheiloplasty with minimal tension, allowing the surgeon to achieve a well-balanced lip contour. Millard's rotation–advancement technique produced excellent aesthetic and functional outcomes.[15] Subsequent two-flap palatoplasty restored the separation between the oral and nasal cavities, improving feeding and providing the foundation for normal speech development.

Post-cheiloplasty care included the use of a nasal clip to maintain nasal symmetry and prevent postoperative scar contracture. If left unmanaged, scar tissue contraction can potentially restrict facial soft tissue mobility and adversely affect normal nasal and maxillary growth.[16] Regular follow-up visits allowed for adjustment of the nasal clip and monitoring of the patient's facial growth. At 18 months of age, the patient exhibited excellent nasal and lip symmetry, with normal eruption of primary teeth and appropriate maxillary arch alignment.

At follow-up after surgical repair, dental development appeared promising. In patients with CLP, eruption of primary dentition is often delayed compared with the non-cleft group.[17] However, presurgical and surgical interventions may support more favorable dental development. In the present case, all primary teeth erupted in proper alignment, suggesting that the combined approach of early nasoalveolar molding and tension-free surgical closure effectively mitigated the eruption delays typically observed in this patient population.

This case demonstrates that nasoalveolar molding with an expansion screw is an effective presurgical strategy for infants with severe premaxillary rotation and space deficiency. Early intervention can significantly reduce the cleft gap and improve nasal morphology. The outcomes observed in this patient align with existing evidence supporting presurgical nasoalveolar molding as a valuable adjunct in cleft lip and palate management, enhancing esthetic, functional, and psychosocial results.

Conclusion

Nasoalveolar molding with an expansion screw is an effective presurgical technique for infants with unilateral cleft lip and palate presenting with severe premaxillary rotation and alveolar collapse. Early intervention allowed controlled alignment of the premaxilla, improved nasal symmetry, and facilitated tension-free surgical repair. The incorporation of a nasal stent promoted balanced nasal cartilage development, while the use of an extraoral strap and denture adhesive improved appliance stability and tissue adaptation. Following cheiloplasty and palatoplasty, excellent esthetic and functional outcomes were achieved. This case highlights the value of customized presurgical orthopedic management as an integral part of multidisciplinary cleft care to optimize both surgical and long-term facial growth outcomes.

Author contributions

TL: Original draft preparation, Manuscript review and editing; TK: Original draft preparation, Manuscript review and editing; and WR: Manuscript review and editing, Resources.

Ethical statement

The patient's consent was obtained before publication.

Disclosure statement

The authors have no conflict of interest.

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