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REVIEW

Presurgical Nasoalveolar Molding of Bilateral Cleft Lip and Palate Infants: An Orthodontist's Point of View

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ABSTRACT

Nonsyndromic complete cleft lip and palate deformity is primarily functional, then esthetic, and finally but not least importantly, a dental challenge. Feeding and facial appearance are important during the first years of a newborn. Nutrition is universally provided by passive feeding plates. If the Cleft Team prefers to use active plates, alveolar molding combined with nasal approaches in infants is the best method to improve esthetics to date. Orthodontists are predominantly responsible for achieving both the goals. After those difficulties have been met in early days of the life, dentists are mainly responsible for the treatment thereafter. If the infants have a dentoalveolar unity without any fistulas and correctly aligned maxillary deciduous teeth, this is a real success. Therefore, this article is an overview of presurgical infant orthopedics and its contribution to subsequent dental practice.

Keywords: Bilateral cleft lip and palate, nasoalveolar molding, columella elongation, infant orthopedics, gingivoperiosteoplasty

INTRODUCTION

The development of facial structures in humans is a quite complicated cycle that occurs between the fourth and twelfth weeks of pregnancy. In that period of fetal gestation, the left and right sides of the facial elements fuse in the middle. When they fail to do so, the result is a craniofacial cleft. Various types of clefts may occur as an isolated condition or as part of a syndrome. This failure in fusion could be genetic and/or environmental preparatory factors.

Dentists are essentially involved in the treatment of healthy, nonsyndromic cleft lip and palate patients. The vital support should be the priority of a cleft patient with a syndrome or systemic disorder.

Although infants born with unilateral or bilateral cleft lip and palate receive a good number of reconstructive surgeries throughout life, they tend to have serious esthetic problems when they grow up. Managing bilateral cleft lip and palate deformity is accepted to be more challenging as the deformity is much more severe than unilateral cleft and palate and involves the lack or even absence of the columella. Therefore, we would mainly focus on such group of patients in this review.

Bilateral Cleft Lip and Palate

Bilateral cleft lip and palate is a congenital deformity in which the premaxilla is suspended from the tip of the nasal septum and posterior alveolar segments and lateral lip tissues remain behind (Figure 1) (1). The premaxilla is rotated to one side in most of the cases. The alar base width is significantly increased and the flattened nasal tip is almost conjoined to the prolabium by severely deficient or absence of columella. The lower cartilages are flared

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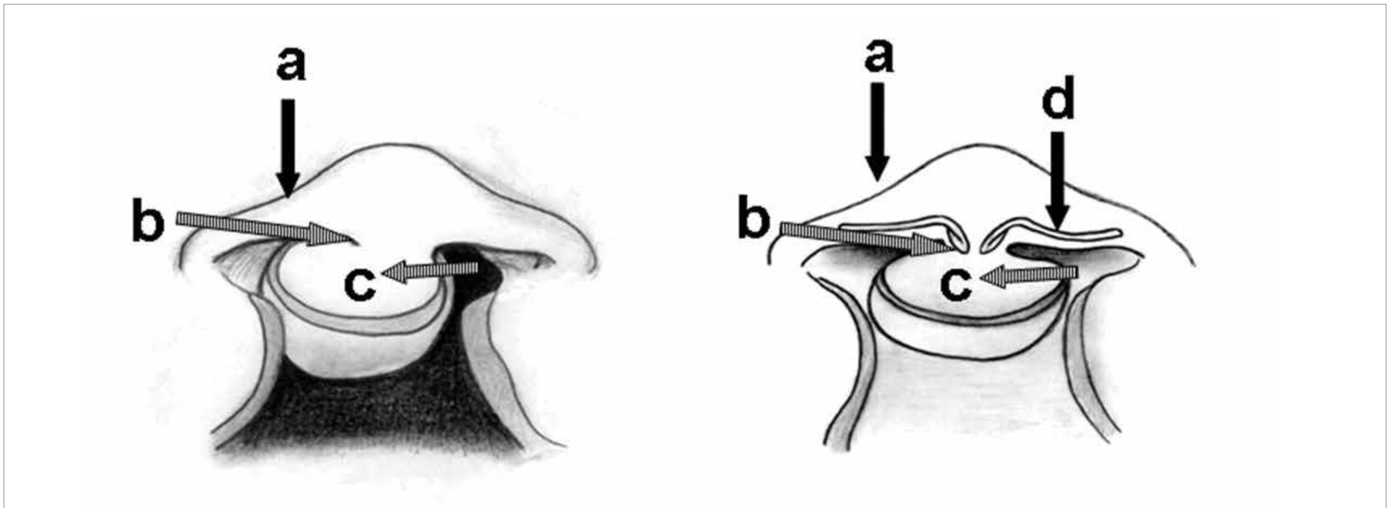

Figure 1. a-d. Lower alar cartilages: In the bilateral cleft deformity, the alar cartilages are flared and have failed to migrate up into the nasal tip to stretch the columella (a, d); columella: shortened, even in some cases not existed (b); prolabium and premaxilla: prolabium lacks muscle tissue and is positioned directly on the end of the shortened columella (c); the premaxilla is suspended from the tip of the nasal septum

Figure 2. a-c. Worms-eye view of a unilateral cleft lip and palate baby (a lip notch on the left side) prior to presurgical nasoalveolar molding (a9; after NAM therapy (b); appliances used (c)

and concave, while they should be convex. The greatest challenge for esthetic reconstruction is the absence of deficient columella (2). Particularly, nonsurgical elongation of the columella is very important in achieving satisfactory surgical results (3, 4). The lack of scarring dramatically improves the esthetics of the face.

Molding of the Cartilages

The original idea for molding of the cartilage was first introduced by Matsuo et al. (5). His hypothesis is based on the fact that the cartilaginous tissues of a new born are softer and their plasticity - ability to be shaped - is higher due to the level of estrogen transferred from the mother. The high level of maternal estrogen increases the level of hyaluronic acid (HA) in the tissues. With the increase in HA, the firm structure of cartilage intracellular matrix loosens. The plasticity of cartilaginous tissues lasts approximately for 3-4 months of age. The level of estrogen decreases, and the cartilage regains its elasticity.

Barry Grayson, DDS and Court Cutting, MD, adopted this theory to the nasal cartilages of infants born with cleft lip and palate (3, 6-8). They have been publishing and sharing their experience of 20 years on presurgical nasoalveolar molding (NAM). As a former member of the team and an orthodontist with 10 years of experience in the area, I would also like to my experience in this technique with its benefits and controversies.

The objective of NAM is to reduce the severity of the initial cleft deformity and to achieve better and more stable results in cleft lip and palate infants. More specifically, retraction of the premaxilla, presurgical elongation of the columella, correction of the nasal cartilage deformity, alignment of the cleft alveolar segments, increase in the surface area of the nasal mucosal lining, up righting of the columella, and achievement of close approximation of the cleft lip segments are aimed. The use of NAM also eliminates surgical columella reconstruction and the resultant scar tissue. Briefly, NAM enables the surgeon and the patient to utilize the benefits of a cleft deformity repair that is of minimal severity (Figure 2 a-c).

Case Presentation

A 1-week-old male infant with a bilateral cleft lip and palate was referred to the Department of Oral and Maxillofacial Surgery. He was examined by a surgeon and an orthodontist. His parents provided informed consent prior to his treatment. His nutrition was managed through a feeding tube. He was diagnosed by right incomplete, left complete cleft lip, and complete cleft palate deformity (Figure 3). At 2 weeks after birth, a conventional molding plate was fabricated on the maxillary cast obtained by an elastomeric impression material. This molding plate was secured in the infant's oral cavity by surgical tapes passing through the buttons. Initially, the molding plate was modified at week-

Figure 3. One-week-old male infant with right incomplete and left complete cleft lip and cleft palate deformity; nutrition provided through a feeding tube before the insertion of the conventional molding plate

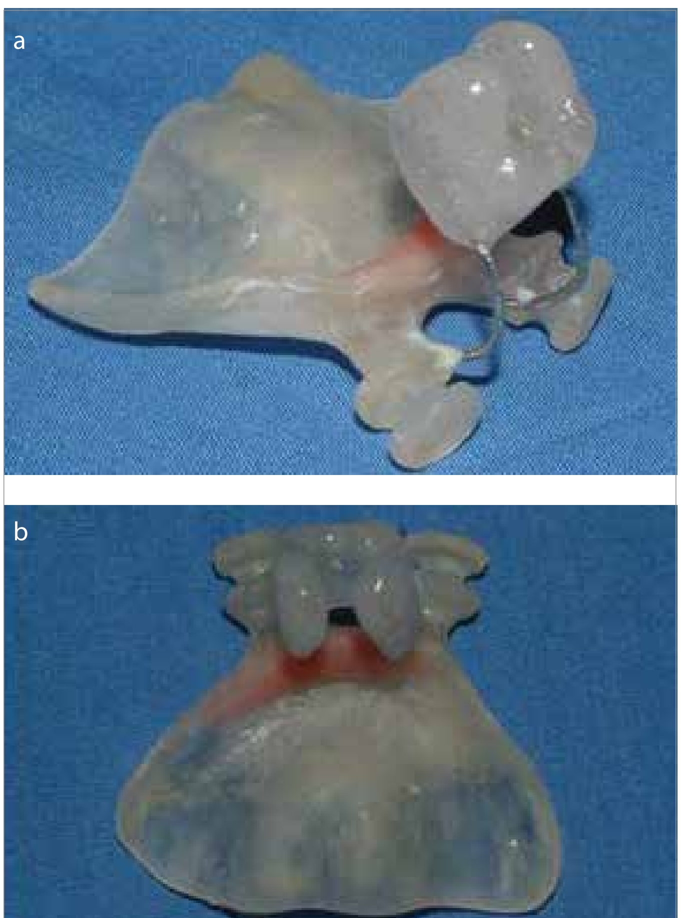

Figure 4. a, b. Alveolar molding plate with nasal extensions (a, b)

ly intervals to gradually approximate the premaxilla and alveolar segments and to reduce the sites of the intraoral cleft gaps. When the alveolar gap was reduced to <5 mm, the nasal stents were added to the labial flanges molding plate (Figures 4a and 4b). The nasal stents were prepared from a stainless steel wire. The sections of the stents that were inserted inside the nostrils

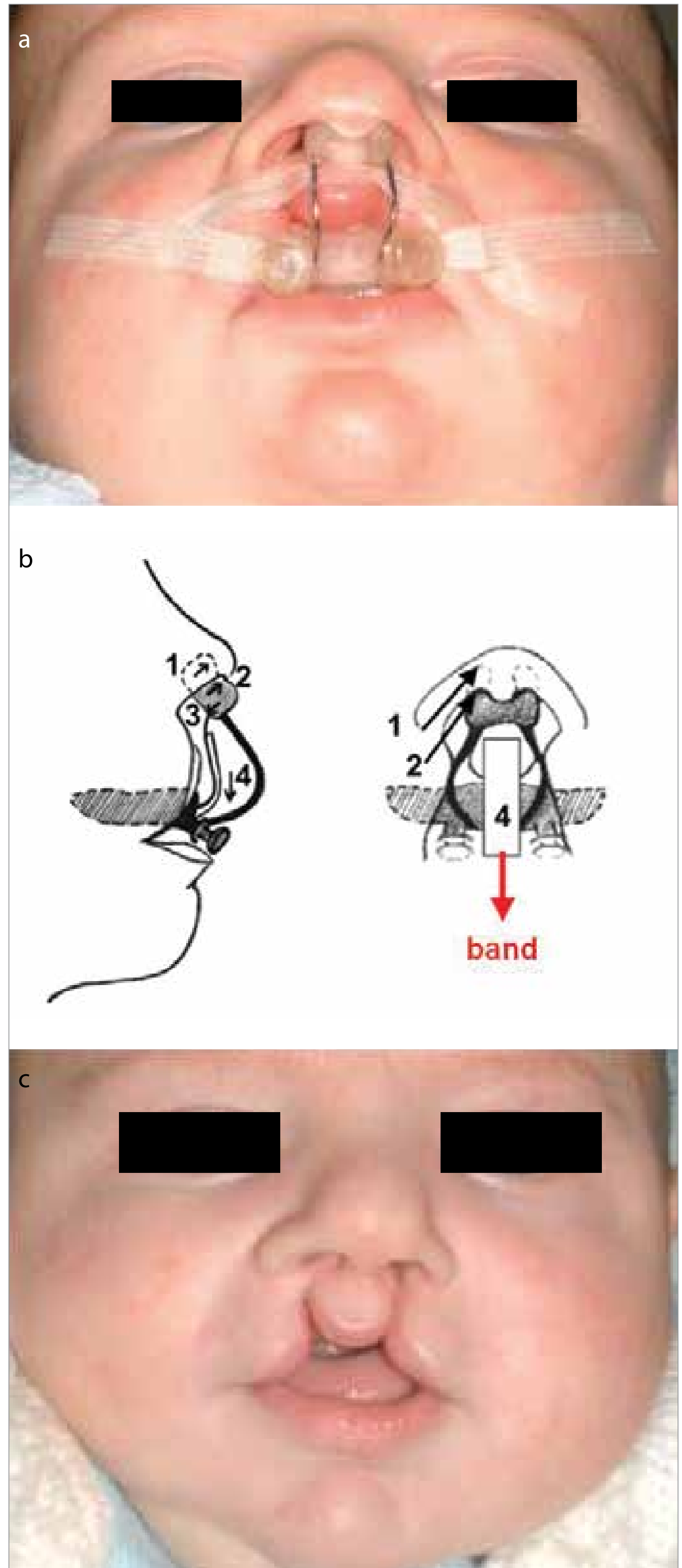

Figure 5. a-c. Nasoalveolar plate in place (a); roles of the nasal stents and the nasal bridge (b); 1. upper lobe of the nasal stent pushes the nasal tip up and forward; 2. lower lobe supports the nasal ridges; 3. elongates the columella 4. labial elastic band pulls the prolabium down and supports the lengthening of the columella; following the NAM therapy (c)

were covered with soft acrylic resin to not irritate the infant's nasal tissues. The weekly activations of the stents are performed by adding a soft acrylic resin.

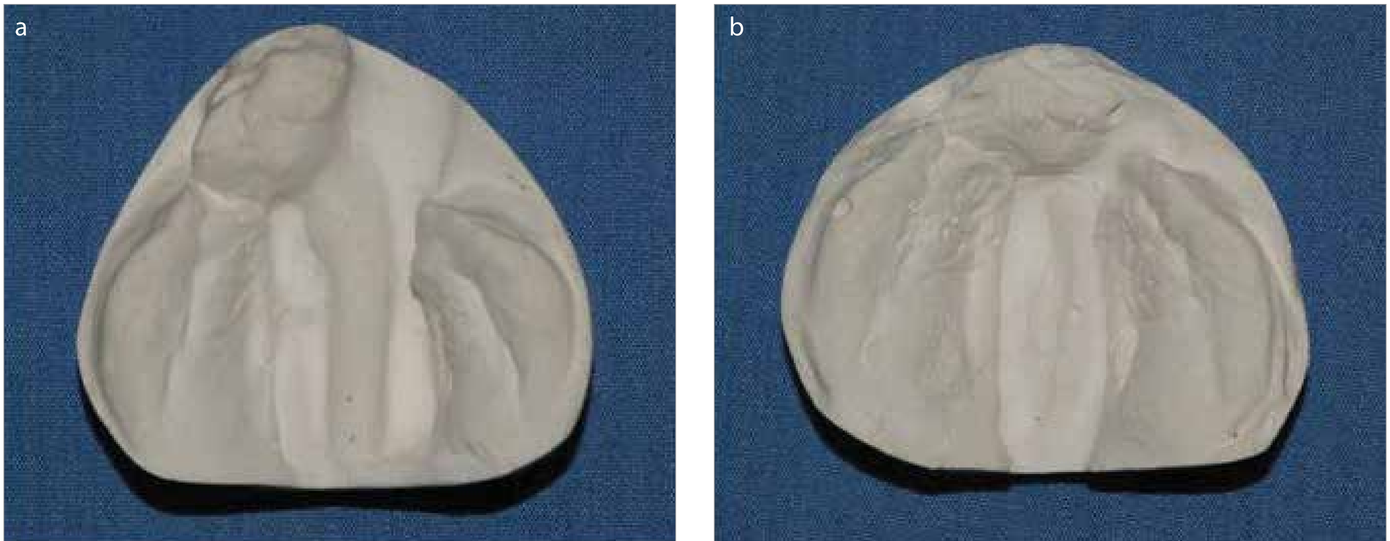

Figure 6. a, b. Study models: before NAM (1 week of age) (a); after NAM (4 months of age)(b)

Figure 7. One month post-op

The nasal stents support the nasal tip and create soft tissue expanding forces that are directed to the columella and nasal lining. In addition, they provide support and give shape to the nasal tip and alar cartilages in the neonatal period while the cartilages are still malleable. When there is enough tissue at the columellar region, the stents are connected with a bridge made of soft acrylic resin. This bridge and the lip bands also help elongate the columella (Figures 5a, b).

After a 2-month 3-week period of presurgical orthopedic treatment, the infant was ready for primary lip and nose repair. The study models before and after NAM are presented in Figures 6a and 6b, respectively.

Surgical Procedure

Primary cheliorhinoplasty was performed at the age of 3 months. For surgical repair of the lip and nose, the Mulliken's method was used under general anesthesia with orotracheal intubation (9). Primary reconstruction of the oral and nasal mucosa, alar cartilages, perioral and nasal muscles, and skin was completed successfully. Following the surgery, a silicon-based nasal stent was inserted, which remained during postoperative first month for supporting the alar cartilages and nasal tip. The postoperative period was uneventful. Esthetical and functional results of the primary cheliorhinoplasty were satisfactory (Figure 7). The patient is followed up periodically, and his palatal surgery was performed at 1 year-3 months (Figure 8). He present age is 10.6 years (Figure 9).

DISCUSSION

Clinical Implications

Most of the publications on NAM are focused on nasal esthetics, tension-free lip repair, and stable esthetic results after surgery. However, it has additional favorable dental outcomes in the

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Figure 8. One-year follow-up

Figure 9. Five-year follow-up

Figure 10. Significantly wide and depressed nasal structure of a complete unilateral cleft lip and palate infant

long-term, which include alignment of the alveolar structures and gingivoperiosteoplasty (GPP).

Retraction of the Premaxilla

Nasal molding could not be performed unless the alveolar bones underneath are adequately aligned. One of the most important rules of NAM is not adding nasal stents until the gap between the alveolar segments is ≤5 mm. If you chose to start with nasal shaping simultaneously with alveolar molding, the result would be meganostrils. If a nasal stent is placed inside this wide right nostril (Figure 10), the stent would act like a tent pole in the middle of a wide alar base. Therefore, in both unilateral and bilateral patients, the very first objective should be to align the alveolar segments.

Another very important issue other than the soft tissues is the protruded premaxilla. In patients with a bilateral cleft, the pre-

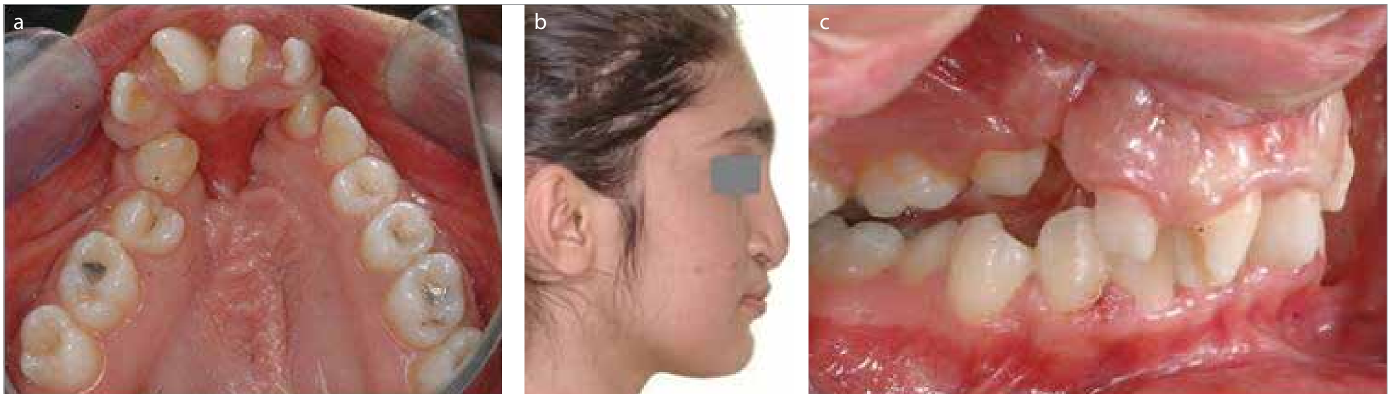

Figure 11. a-c. A young adult who did not receive any presurgical infant orthopedics (a); intraoral occlusal view; extraoral profile photograph (depressed nose and scarred-lip) (b); intraoral lateral view focusing the significant over-extrusion of the premaxilla (c)

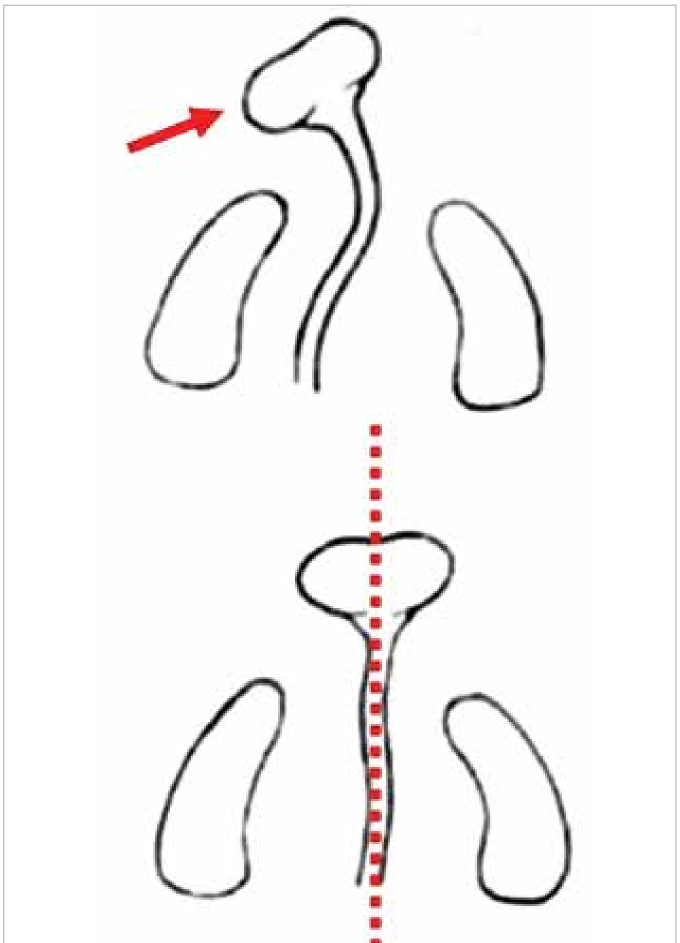

Figure 12. Up righting the rotated premaxilla before the retraction

maxillary segment is often displaced anteriorly while the posterior segments are palatally collapsed behind it (Figure 11a – from the archives of Dr Ufuk Toygar Memikoğlu). If the lip segments are sutured while the premaxilla is still protruded, the surgical closure of the lip can be extremely difficult (Figure 11b). Due to the uncontrolled tension applied by the scarred-lip, over-extrusion and bending of the premaxilla is inevitable (Figure 11c).

First, the palatally collapsed maxillary posterior segments must be expanded. A backward force should be applied to the premaxilla by adding a softer acrylic resin inside the molding plate. Another important rule is to upright the rotated premaxilla before applying a backward force (Figure 12).

In infants, the segments can be repositioned surprisingly fast and easily. Thus, the first stage of NAM is completed in a few weeks at the most. Thereafter, the infants are ready for their nasal shaping.

Therefore, a very important benefit of NAM is to align the premaxilla and posterior segments and to prepare a perfect infrastructure for nasal molding and future orthodontics.

Gingivoperiosteoplasty

In complete cleft lip and palate patients, the bony defect involves both the primary and secondary palates. There are three major methods for the closure of the cleft alveolus: primary bone grafting during the primary nasal and lip closure (approximately 5 months of age), secondary bone grafting (before the eruption of maxillary permanent canines, approximately 9-11 years of age), and GPP. Primary alveolar bone grafts in infancy appears to be contraindicated as this procedure is believed to interfere with the later growth of the maxilla. GPP has also been claimed to have adverse effects on the maxilla.

GPP is a surgical procedure resulting in the formation of a periosteal tunnel between the cleft alveolar segments in hopes of achieving a bony union. GPP, when first introduced by Skoog, needed more undermining of the alveolar periosteum as the cleft segments are widely apart (10). Millard and Latham advocated a more conservative GPP procedure, which involves reducing the extent of maxillary and alveolar periosteal undermining (11). The Millard-type GPP requires presurgical infant orthopedics to minimize the alveolar gap. It has been demonstrated that GPP has a high osteogenic potential of the periosteum and enables the maxilla to be filled-in with adequate bone (12). This offers stability to the jaw as a whole and more normal anatomical condition for the growth of maxilla.

Santiago et al. (13) found that 60% patients who underwent NAM and Millard-type GPP did not require secondary bone grafting. Sato et al. reported that in the remaining 40% who did need a bone graft, there was more bone remaining in the graft side

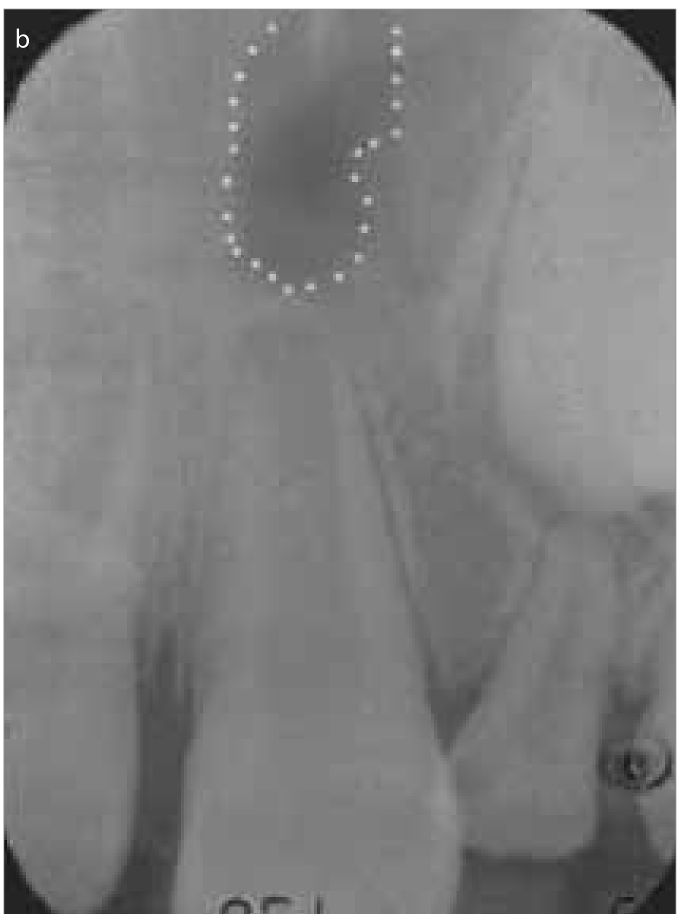

Figure 13. a, b. complete right unilateral cleft lip and palate before secondary alveolar bone grafting following GPP with inadequate bone bridge. Note the existing bone bridge and erupted deciduous teeth on the cleft alveolar ridge but a small nasal floor notch is present; b. GPP alone. Note the deciduous tooth erupted into the former cleft site (Sato et al. (12), 2008)

than in patients who did not previously undergo GPP (Figures 13a and b) (12). This is explained by the presence of bone bridges in the graft site resulting from the primary GPP. The authors also mentioned that GPP alone or combined with secondary alveolar bone grafting results in superior bone levels when compared with secondary alveolar bone grafting alone. They also reported that 73% of patients who have undergone GPP avoided the need for secondary alveolar bone grafting.

However, there are many controversies on GPP and maxillary growth. Many studies have reported that in patients who underwent GPP performed during primary lip closure, the maxillary growth was more restricted compared to the non-GPP patients (14-16). Contrary to the claims, the Millard-type GPP has been shown to not have an effect on the long-term maxillary growth (17). Grisius et al. (18) reported no significant differences in the orofacial morphology in the GPP group compared with a non-GPP sample.

As per our understanding, GPP is preferred in our patient sample. As an orthodontist, I would definitely prefer an intact maxillary dental arch to a slightly retruded maxilla. We have excellent mechanics to position the maxilla forward in a very short period (for e.g., facemasks). If successful orthopedic maxillary advancement during early childhood of adolescence cannot be achieved, LeFort osteotomies are another option in older ages. A significant number of cleft patients, particularly unilateral ones, most likely are candidates for LeFort-maxillary advancement procedures. This is valid for almost all clefts irrespective of GPP. Hsieh et al. reported <3° degrees of SNA difference between patients without GPP compared to the GPP group (79.5° and 82°, respectively) (16). In addition, it should always be noted that maxillary retrusion is mostly a problem in unilateral cleft patients and not bilateral. Moreover, expanding a slightly constricted maxillary dental arch - it is inevitably constricted in almost all cleft patient - would be more favorable than a dental arch with fistulas. With the alveolar segments in a better position and increased bony bridges across the cleft, the permanent teeth have a better chance of eruption in a good position with adequate periodontal support (19). Therefore, orthodontic treatment of a cleft patient who underwent NAM and GPP is less challenging and more promising.

CONCLUSION

With proper training and clinical skills of the orthodontist and surgeon, presurgical nasoalveolar molding and GPP have demonstrated advantages of pleasing and stable nasolabial esthetics with less scar tissue, intact maxillary dental arch without any oronasal fistulas, and reduction in the number of soft tissue revision and alveolar grafting surgeries. When we scale the advantages and disadvantages, the NAM plus GPP option should be preferred.

Informed Consent: Written informed consent was obtained from the parents of the patient who participated in this study.

Peer-review: Externally peer-reviewed.

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