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The Role of the Pediatric Dentist in the Cleft Palate and Craniofacial Team

Prof. Patrizia Defabianis. Dr. Eyal Botzer
Israel

Orofacial clefts are the most common oro-facial anomaly in newborn infants and the second commonest congenital abnormality, affecting approximately one in every 800 births worldwide. It is a non "life-threatening" abnormality, which can have significant effect on maternal bonding and include cleft lip with or without cleft palate (CL/P) or isolated cleft palate (CP), the former being more frequent than the latter. Submucous clefts are rarer (1/1200 births).

Clefs differ with respect to embryology, etiology, candidate genes, associated abnormalities, and recurrence risk; they can occur in isolation or as a part of a broad range of syndromes[1]. Depending on their exact location, these growth disturbances result in different defects and can be divided into three main types: isolated cleft Palate (**Fig. 1**); unilateral cleft lip with or without cleft palate (**Fig. 2**); bilateral cleft lip with or without cleft palate (**Fig. 3**).

Nowadays there is still disagreement about technique, timing and sequence in treatment planning. Successful treatment requires a multidisciplinary approach, but there is no consensus in sequence due to lack of randomized clinical trials comparing outcomes and effects of timing[2,3]. Several approaches have been published on early management of the alveolar segments and the dislocated pre-maxilla and nowadays we are more and more confronted with a world-wide tendency in favor of the all-in-one operation to close clefts of the lip, alveolus and palate. Unfortunately, surgical methods widely vary from center to center; every center has its own protocols with no fixed rules about the order in which individual cleft sections are closed and/or at what age. Anyway, long-term treatment is required with not always satisfactory outcome as it is well-known that all types and timings of surgical repair are detrimental to maxillary growth. Usually the first surgery of the lip and nose at the age of 3 months or so, surgical closure of the palate at the age of 9-12 months, when some protocols defer the clo-

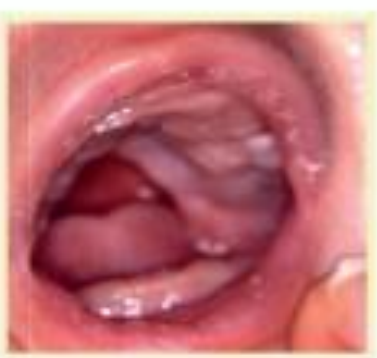


Figure 1. Isolated cleft palate.

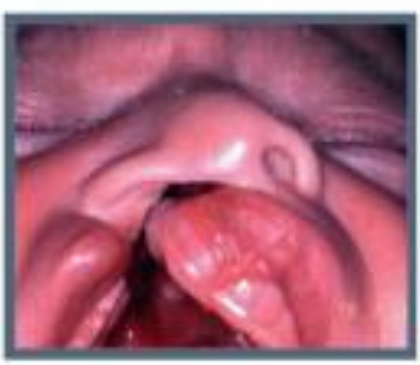


Figure 2. Unilatera Cleft lip and Palate.

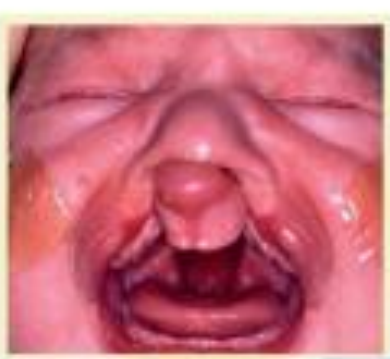


Figure 3. Bilateral Cleft lip and Palate.

sure of the hard palate till the age of 4 years. The next stage is surgery for pharyngeal function at age 4 and up only when necessary.

The alveolar cleft is closed by bone graft before the eruption of teeth into the cleft site meaning ages 7-11 years. Orthognathic surgery may be considered at the end of growth when needed.

Additional surgeries such as reshaping of the nose or removal of excess lip tissue can be considered depending on the situation of any single patient.

Due to the prevalence of this malformation, there is no doubt that every dentist or orthodontist will encounter a cleft patient during his or her professional life. Better knowledge of the treatment phases and possibilities including functional therapy options will improve the dental and overall care delivered to these patients around the world.

Care of a newborn with cleft lip and palate requires a multidisciplinary team and every medical center that treats craniofacial defects should have a multidisciplinary team including a plastic surgeon, a speech and language pathologist (SLP), an Ear Nose and Throat surgeon (ENT), a maxillofacial surgeon and an orthodontist. However, a more comprehensive team should include a social worker, a pediatrician, a psychologist or a child psychiatrist, a pediatric dentist and a prosthodontist.

All team members should accompany the infant during the years to adulthood, as a healthy body and a healthy mind person.

TREATMENT PHASE 1: INFANCY (0-6 MONTHS)

Isolated Cleft palate

Cleft palate appears often as part of the "Pierre Robin sequence". Due to posterior tongue position ("Glossoptosis") airway and breathing difficulty may develop thus leading to feeding difficulties and then created "vicious circle": no sufficient caloric intake resulting in decreased muscular tone, the tongue falls backwards even more and the respiratory difficulties are worsened and so on....

In the past it was the dentist's role to install an obturator - feeding plate that allowed more efficient feeding, thereby increasing the newborn's caloric intake and preventing the glossoptosis. One of the first feeding plates that also helped the tongue position was the "Hotz Plate" (**fig. 4, 5**).

Today, there are special feeding bottles which allow almost all newborns with a cleft to feed without the feeding plate.

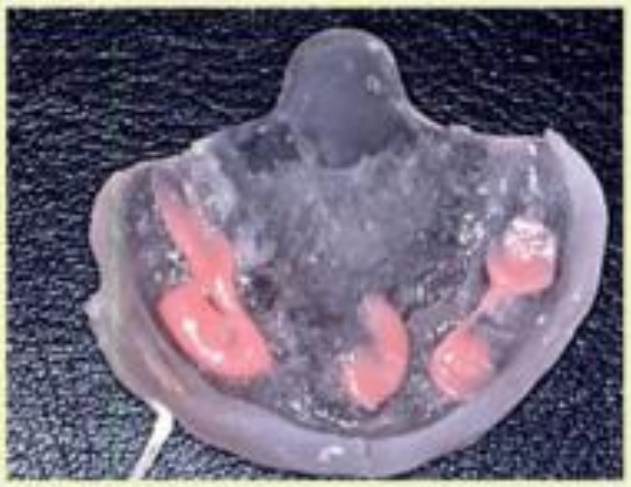


Figure 4. Hotz plate.

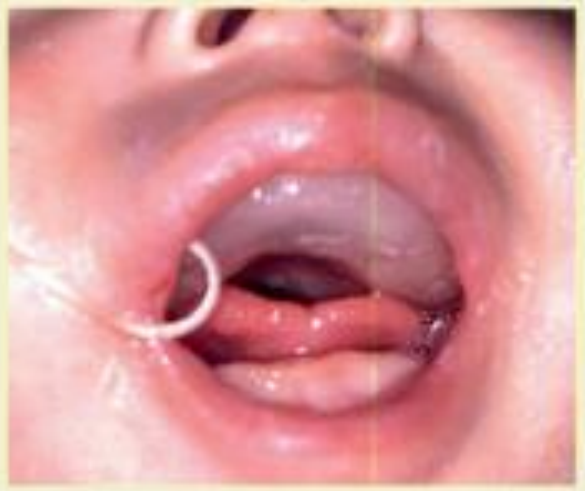


Figure 5. Hotz palte inserted and the forward tongue position.

In severe cases where the mandible is severely retrognatic and airway is impaired, there is a range of treatments to secure the airway such as "Nasal Airway" insertion or even tracheotomy or Distraction Osteogenesis to advance the mandible and open the airway.

Cleft lip and palate

Infants with cleft lip and palate often present a cleft of the alveolar bone, and as a result, the bone segments are distorted in different directions and there is a soft tissue gap. During development in the womb, certain tissue structures do not fuse. It is very important to underline that cleft always results in a deficiency of tissue and not in a mere displacement of normal tissue and are characterized by an important anatomical disruption of the lip muscles, in particular of the orbicularis muscle. In unilateral cleft lip and palate (UCLP), the orbicularis muscle is interrupted and diverted: its fibers are atrophic and run upwards and parallel to the edge of the cleft, and are inserted at the base of the columella medially and at the nasal wing laterally (see **fig. 2**). The more severe the cleft, the more difficult it is to achieve pleasant postoperative results due to the presence of abnormal maxillary growth vectors: during oral function (feeding, crying, smiling etc.) the columella on the non- affected side and the nasal wing on the cleft side are stretched in opposite directions, increasing so the width of the cleft. The defect affects the external portion of the upper lip, the alveolar ridge, the hard and soft palate; the nasal floor communicates with the oral cavity, the maxilla on cleft side is hypoplasic, the columella is displaced to the normal side and the nasal wing on the cleft side is displaced laterally, posteriorly, and inferiorly increasing so nasal deformity. The loss of facial symmetry, the disruption of the bone segments, the interruption of the muscles that contribute to further displacement of the margins of the cleft and the increasing deformity of the nasal structures, are the main features in these patients. The nasal septum is deviated to the healthy side, the

chin is deviated to the affected side, the columella is stretched and this results in the displacement of the tip of the nose. In these conditions, mechanics of facial growth is seriously affected and results in an asymmetry of the premaxilla (which is tilted up toward the cleft side), and a deviation of the nasal septum (which bulges towards the cleft side). In bilateral cleft lip and palate (BCLP) the orbicularis oris muscles run parallel to the edge of the cleft and inserts into the alar margin. The lip and the alveolar ridge are absent under both nostrils and the central portion of the lip, alveolar ridge, and the premaxilla are positioned abnormally. In these patients the columella is very short, the deformities of the nose are generally important due to the stretching of the alar cartilages during oral function, and the tip of the nose is directly attached to the lip. Generally speaking, these patients may develop airway distress because of the tongue lodging in the palatal defect further increasing the cleft width.

The role of the pediatric dentist or the orthodontist is to prepare the infant for his lip and nose surgery, so the alveolar bone segments are aligned and the soft tissues are located in good proximity and the plastic surgeon can perform surgery with no tension in the soft tissues and minimal scarring. Some surgeons are performing a Gingivo Periost Plasty (GPP) consisting in a bony connection of the alveolar segments thus reducing the need for bone grafting at an older age. The process of approximating the alveolar bone segments is called Pre-Surgical Orthopedics (PSO). The effect of PSO on maxillary arch has been a subject of debate for many years, but controversy regarding the effect of PSO on its growth still exists. Advocates of PSO claim that the pre-surgical orthopedic plate molds the alveolar segments into a better arch form and prevents the tongue from positioning in the cleft, improving so the dentomaxillary development[4-7]. Opponents of this therapy claim that lip surgery alone has the same effect and that the pre-surgical orthopedic plate is only an expensive appliance used to comfort the parents by starting treatment at the earliest possible moment[8-12].

Before PSO started, the surgeons had been removing the Premaxilla surgically. Only in the 19th Century did they start to conserve the Premaxilla, either by back sliding of the premaxilla or by surgical Lip Adhesion. In the 20th century started combination of PSO and surgery.

In1844 Huilihen used adhesive tape binding to retract the premaxilla. In 1927 Brophy used a silver wire through both the ends of the cleft alveolus to approximate the segments and in 1951 McNeil used a series of "non fitting" intraoral acrylic plates to mold the alveolar segments into the desired position – very similar to todays' Invisalign method. Following McNeil's work, Latham and Millard developed metal devices " the Latham appliance" that is retained to the palate by pins and bends the alveolar segments toward each other. This appliance "won" many opponents mainly due to its invasiveness and also because of the fact that almost all patients undergoing GPP presented an anterior X-bite and Class 3 occlusal relations. In the beginnings of the 1980. Grayson and Cutting from the Institute of Reconstructive Plastic Surgery of the New York University developed a modified technique for alveolar molding, they

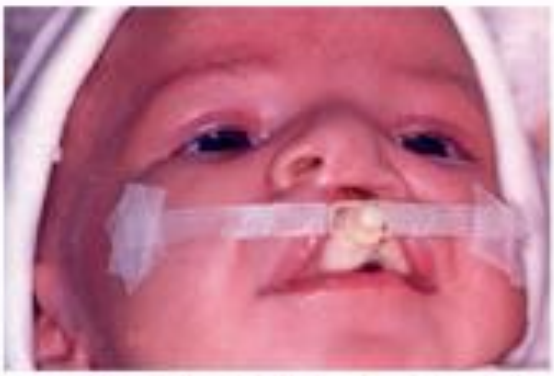


Figure 6. Active plate held with elastics to the cheeks.

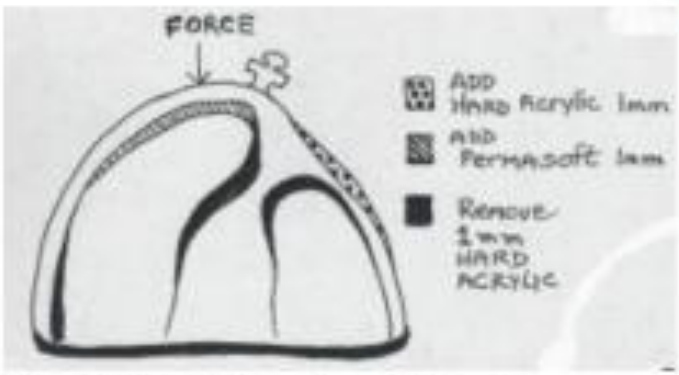


Figure 7. Original slide courtesy of Dr. Barry Grayson: areas of grinding and adding soft lining to the molding plate.

used an acrylic plate as the Hotz plat that was modifies once a week with adding soft lining material on one side or the alveolar segment and grinding the inner part of the plate on the opposite side of the bone in order to redirect the alveolar segments' position and growth towards the desired position (**Fig. 6, 7**).

There are 2 types of PSO:

1. Active plate- The plate does not fit the alveolar bone shape and molds the segments by applying a gentle force. In this technique there is high control over the force vectors but there is a possible growth interference

2. Passive plate-The plate only prevents collapse of the alveolar segments. Usually combined with Lip Adhesion and it probably does not interfere with growth.

When moving the bone to the desired position, the soft tissues that are above are being approximated too, thus the plastic surgeon is able to operate on an easier and stress-free

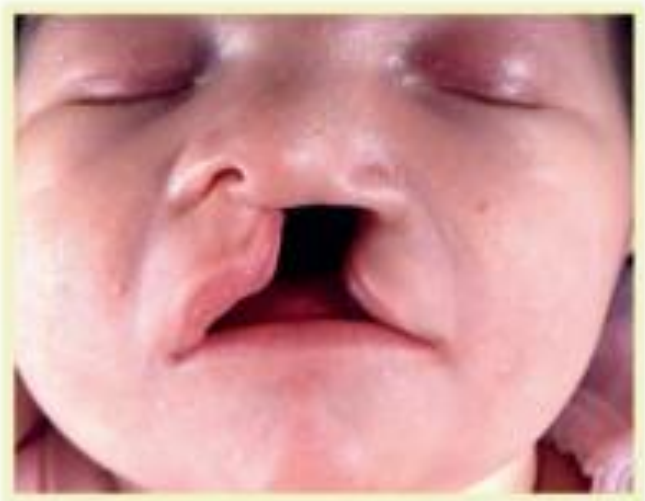


Figure 8. Soft tissues before PSO.

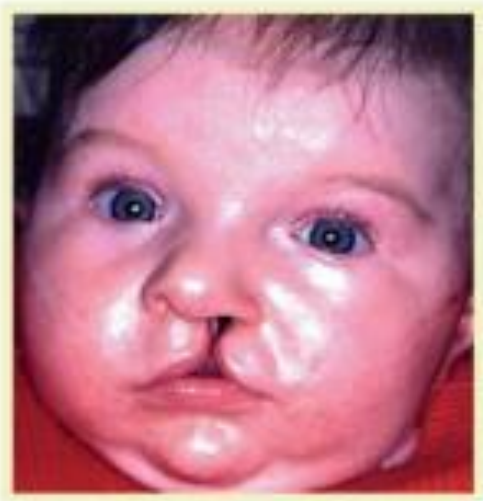


Figure 9. Soft tissues after PSO.

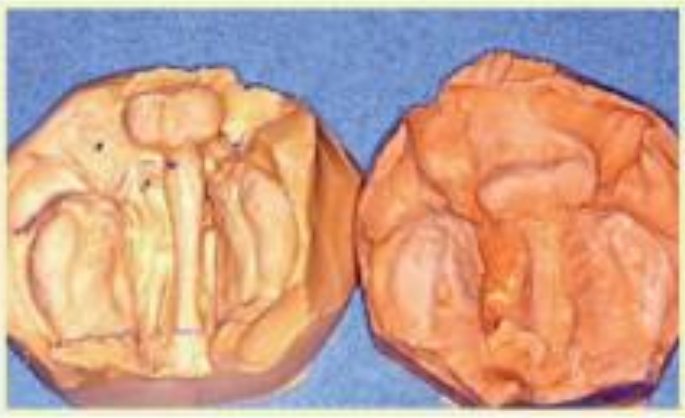


Figure 10. Hard tissues before and after PSO.

tissue. In fact, many plastic surgeons prefer this preparation before surgery (**Figs. 8, 9, 10**).

Nasal Molding

Another problem described in literature is that surgical reconstruction of the nasal structures may hinder the nasal airway to such an extent that the patient breath through the mouth as well[13]. Sometimes, surgical procedures increase nasal resistance to the degree that the child would start breathing through the mouth. Indeed, nasal asymmetry, columellar deficiency, and deformation of nasal cartilages are important factors contributing to an increased nasal resistance. This might result in a variable degree of growth deficiency[14,15].

Dr. Barry Grayson and his colleagues at NYU, developed a technique that corrects the deformation of nasal cartilage and distorted nose of the cleft lip patients this treatment is called NAM – Naso Alveolar Molding[16].

The background to NAM are the findings of the Japanese group led by Kiyoshi Matsuo which shows that auricular cartilage can be shaped and molded in newborns (**Fig. 11**). The newborn's cartilages have some degree of plasticity immediately after birth for a limited time. By molding the nasal cartilages, we can significantly improve the esthetic outcome of the cleft patient.

In the NAM treatment, a stent is added to the active PSO plate. Its aim is to effectively reshape the nasal cartilage and mold the maxillary arch before primary surgery. NAM components consist in the use of an orthodontic wire from the palatal prosthesis with an acrylic bulb positioned inside the nose, underneath the apex of the alar cartilage, as the nasal stent. The aim of this procedure is to elevate the wing and the

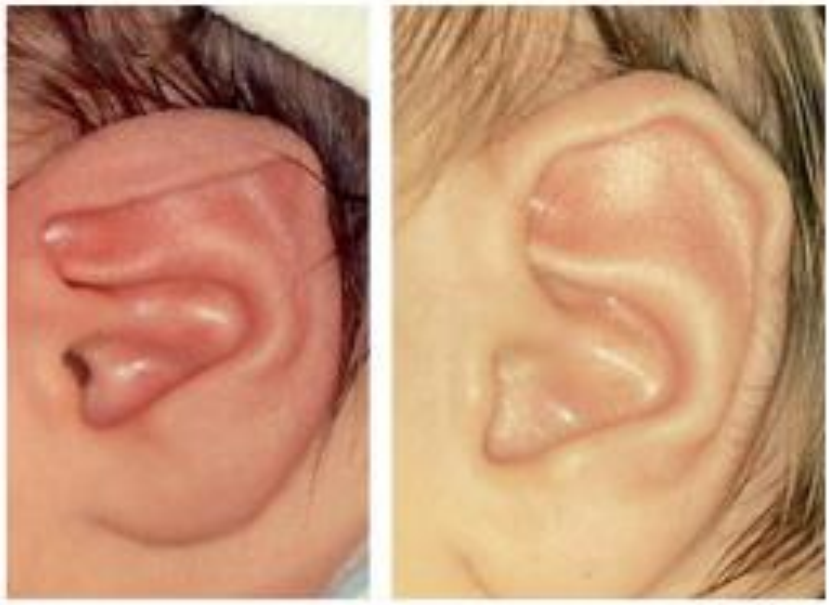


Figure 11. Auricular cartilage before and after molding.

tip of the nose during the 3 to 6 months prior to surgical repair, thus inducing improved rounding of the nostril on the cleft-side and reduced alar flattening following primary nasoplasty[17,18]. The stent is inserted into the deformed nostril and with gentle force application, the nose shape is corrected and the nasal columella is elongated to the proper length. The NAM treatment lasts 3-6 months with weekly visits before the first lip surgery. (**Figs. 12, 13, 14, 15**).

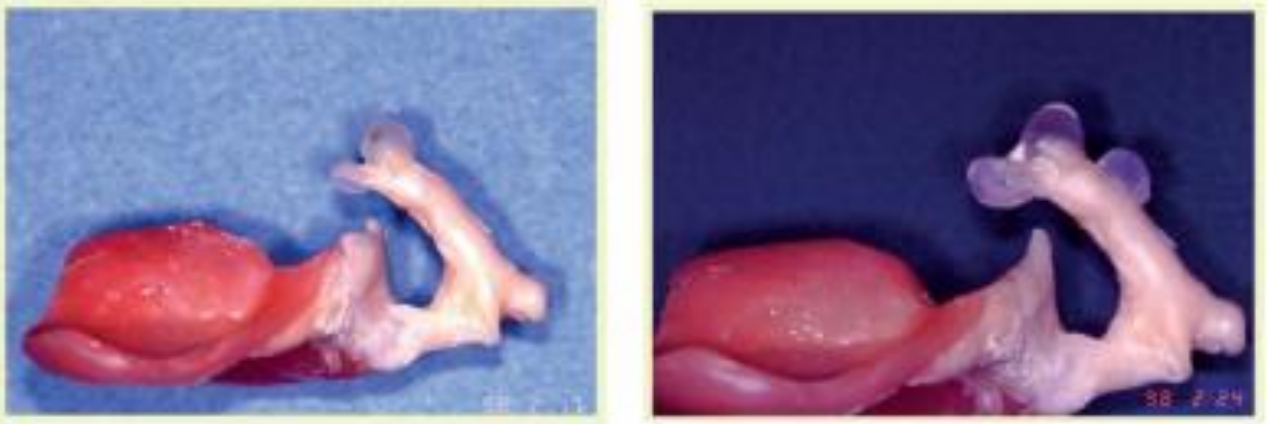


Figure 12. The Change in the nasal stent size during treatment.

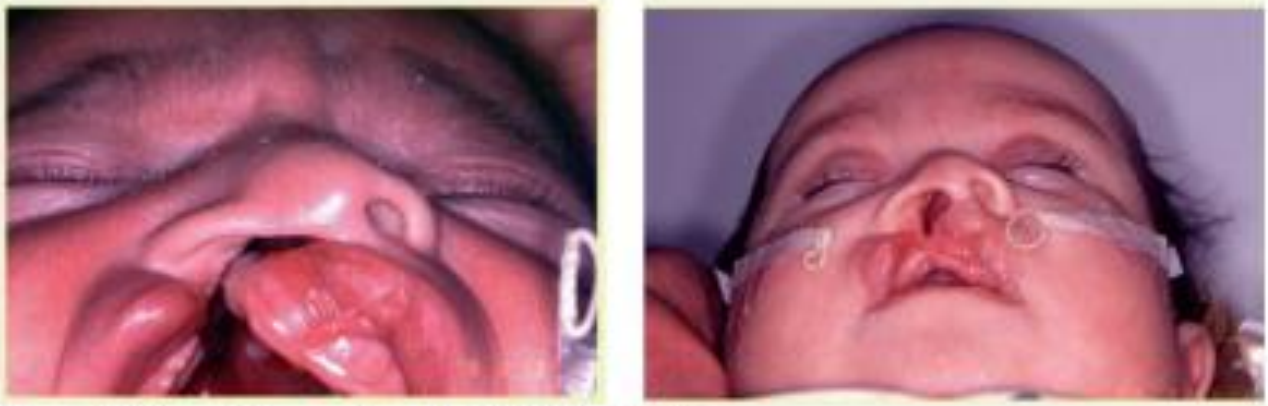


Figure 13. Change in the nose in a unilateral cleft lip and palate.

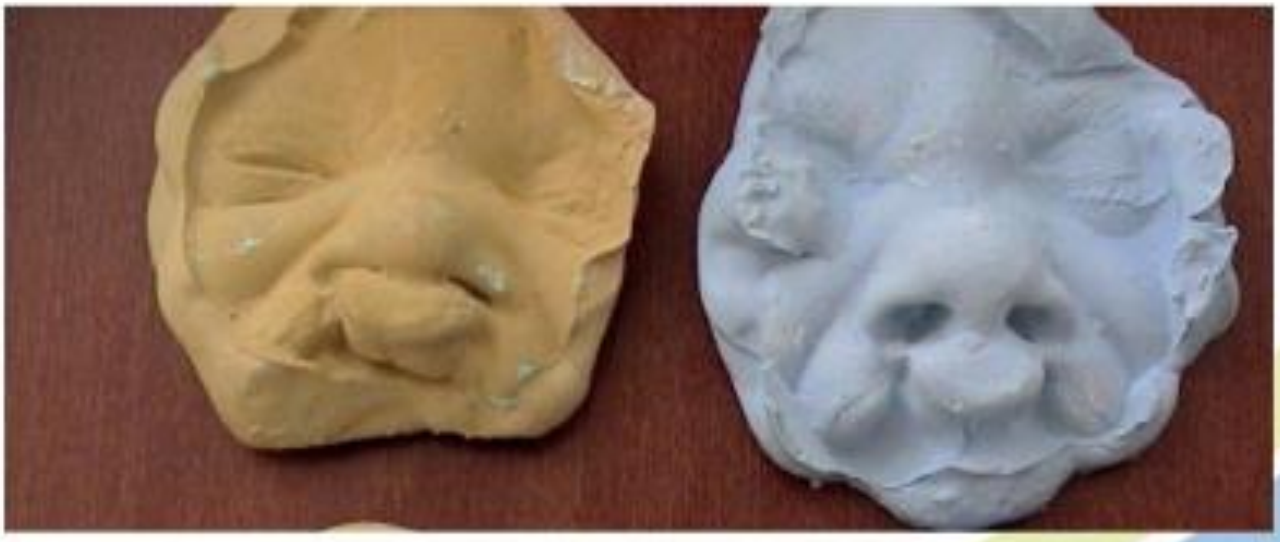


Figure 14. Change in the nose and columella in a bilateral cleft lip and palate.

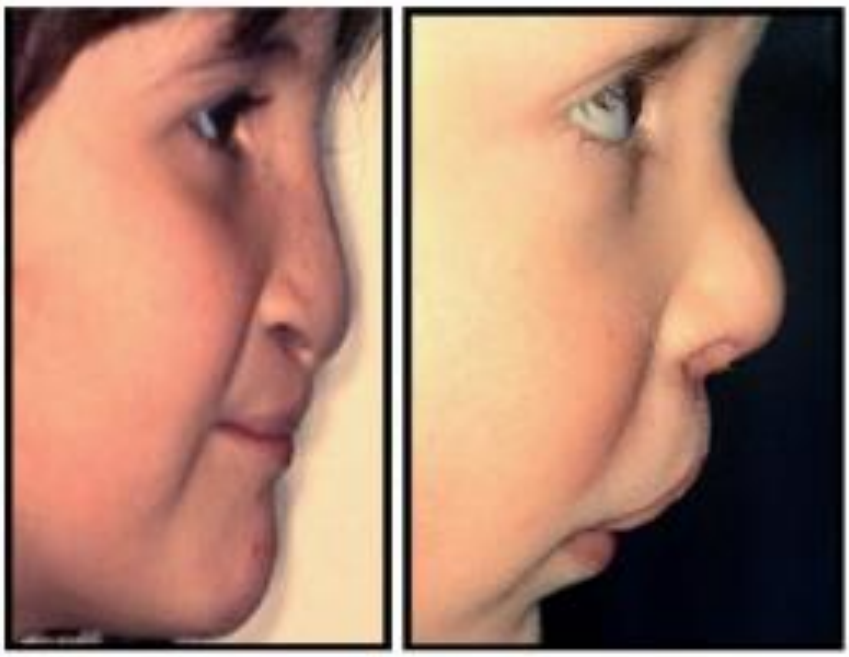


Figure 15. Lateral view of a bilateral cleft without NAM and with NAM.

Nasal alveolar molding has been shown to be an effective method to normalize the anatomy of the nose and maxillary arch and to minimize asymmetry by lengthening the columella, reshaping the nasal cartilages, and molding the alveolar processes. Furthermore, it provides aesthetic and functional benefits of nasal tip and alar symmetry. In bilateral cases, it successfully helps in retracting the premaxilla posteriorly, lengthening the deficient columella and favor the repositioning of the apex of the alar cartilages toward the tip of the nose. There is a simple version of Nasal Molding that was developed at the Tel Aviv Medical Center for incomplete cleft lip case, where the nose is deformed but there is bony support at the nostril floor. A simple use of Nasal Oxygen Cannula that is cut in its anterior part to allow breathing and inserted into the nose. The deformed nostril can be molded by adding soft dental lining material and the cannula is retained to the cheeks by adhesives (**Fig. 16**).

Neonatal Teeth

Neonatal teeth are a very frequent finding in a cleft lip patient. The tooth buds are very close to the surface and erupt soon after birth. Most of the times these are the lateral decidu-

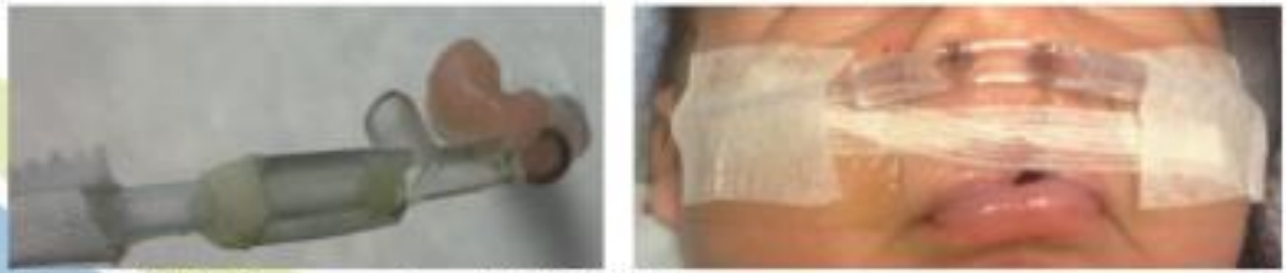


Figure 16. Modified Oxygen nasal cannula for Nasal Molding.

ous teeth and in most cases extraction of the tooth is indicated because the tooth may interfere with the lip surgery and the GPP.

TREATMENT PHASE 2: TODDLERS (AGES 6-36 MONTHS)

Retention Plates

Sometimes, a retention plate is needed to prevent the alveolar segments from collapsing after surgery.

Toddlers with retention plates should be monitored regularly to allow expansion and growth of the palate and allow the teeth to erupt.

Prevention

At this age we must begin prevention of dental caries. Infants with cleft lip and palate are at high risk to develop tooth decay for many reasons. First of all, often teeth are affected by more or less severe enamel defects (enamel hypoplasia etc.) due to invasive surgical procedures, while lip surgical scares and dental malposition (rotation etc.) make oral hygiene procedures difficult to perform.

TREATMENT PHASE 3: AGES 3-12 YEARS

At this phase the focus is on preventive and preservative care. Sometimes, it is necessary to help the speech and language pathologist with installing several obturators to close Oro-Nasal fistulae to improve speech (**Fig. 17**).

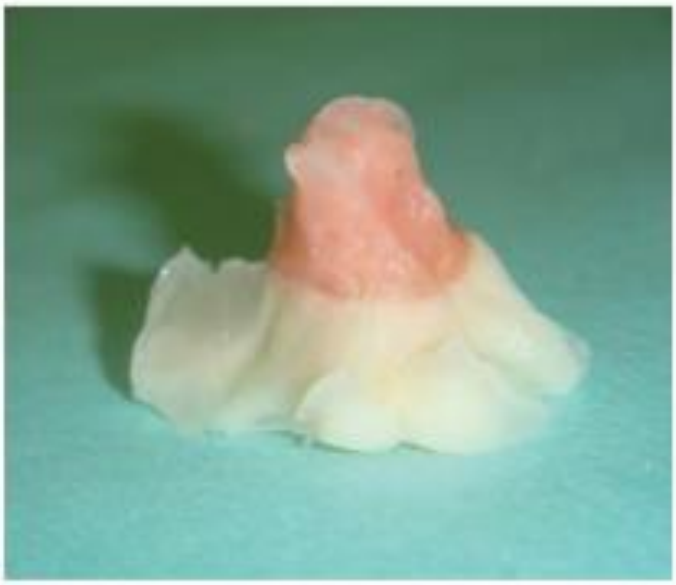
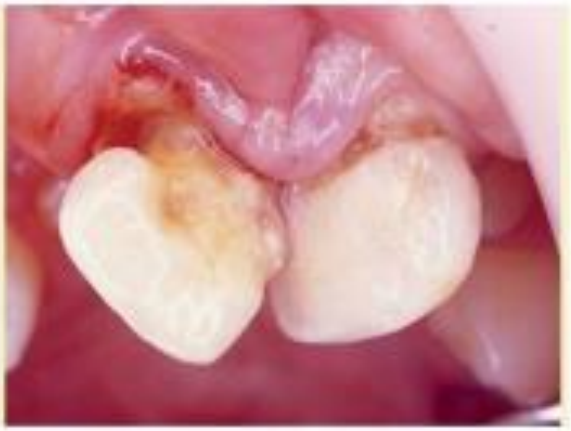


Figure 17. Obturator of Oro-nasal fistula.



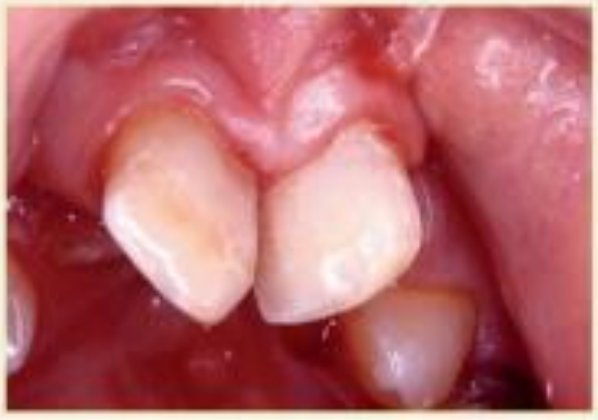


Figure 18. Malformed teeth and subgingival restoration.

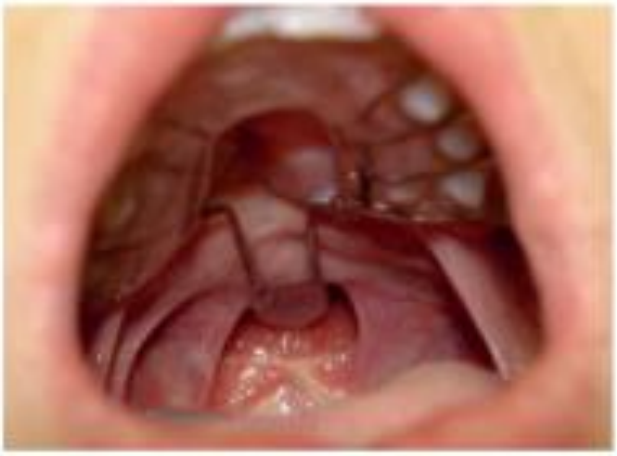


Figure 19. Palatal Bulb.

Many children undergo orthodontic and functional orthodontic treatments. (**Figs. 20-25**).

Again it is highly important to preserve the teeth at the cleft site. Also since the permanent teeth may be deformed, the restoration may require imagination and improvisation and often using the Electro surgery to allow restoring sub gingival areas (**Fig. 18**).

Figs. 20-25. Example of a functional orthodontic treatment for a cleft patient:

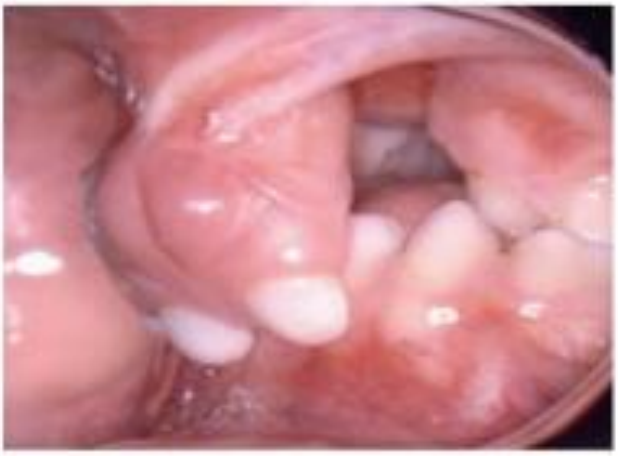


Figure 20. *M.B. aged 3. Female patient affected by a bilateral cleft lip and palate with an evident vertical excess of the pre-maxilla. This condition is due to an unusual growth at the vomer cartilagenous- premaxillae junction, worsens with age and causes serious psychological problems to the child and the family. In the most severe cases bone graft placement is not possible.*

Figure 21. *Lateral view of the same patient.*

Figure 22. The functional appliance (Sn6) used to improve the deep bite. It has a central screw to correct horizontal discrepancy, an anterior bite (equiplan) to correct vertical discrepancy, a buccal arch and a lower vestibular shield to control sagittal discrepancy

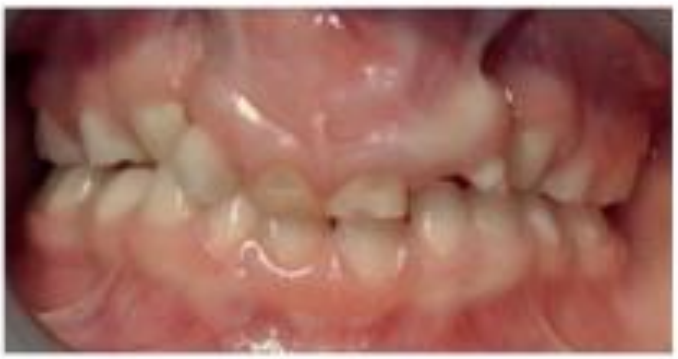


Figure 23. Intra-oral view nine months later showing the repositioning of the pre-maxilla.

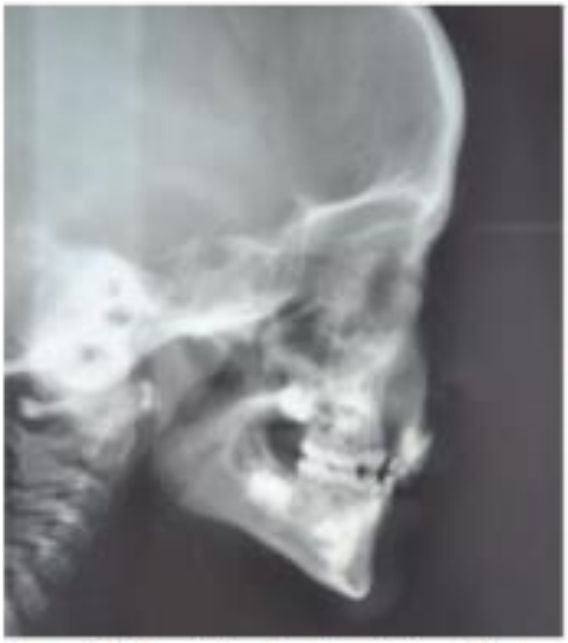


Figure 24. The latero-lateral cephalometric projection showing the intrusion of the pre-maxilla.

Figure 25. Lateral view of the patient at the end of the treatment.

Healthy teeth are imperative for the success of other surgical procedure in the patient, since dental caries and infection may lead to infection and surgical failure of fistula closure, bone graft or palatal flap surgeries.

In case a tooth at the cleft site should be extracted for the bone graft surgery, it is recommended to extract the tooth 2-4 weeks before the surgery, to allow proper healing of the soft tissue without losing the precious alveolar bone that supports that tooth.

TREATMENT PHASE 4: ADOLESCENCE (AGES 13-18)

This phase too is characterized by intense preventive measures mainly due to the fact the there are some kind of orthodontic appliances in the mouth for long periods of time that diminishes the ability to maintain proper oral hygiene.

Frequently, the pediatric dentist or the orthodontist work closely with the SLP and the ENT to adapt special obturators for palatal closure as Palatal Bulb or Palatal Lift (**fig. 19**).

CONCLUSION

In our experience Pre Surgical Orthopedics (PSO) is an excellent way to control maxillary growth and improve dento-maxillary development by molding the alveolar segments into a better arch form, preventing so the tongue from positioning in the cleft.

The dentist is an integral part of the Cleft and Craniofacial Team. The dentist is the one who is in close and intensive contact with the newborn's family from early in life because of the NAM treatment and after that routinely for the check-ups and maintenance appointments. With the goal of working together with the rest of the team helping the family grow their child as normally as possible and become a healthy and fully functioning person both in mind and esthetic appearance.

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