Dynamic Cleft Maxillary Orthopedics and Periosteoplasty

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Abstract: In 1985 this cleft team, dissatisfied with the treatment and results from cleft lip and palate repair, began a longitudinal long-term study using dynamic maxillary orthopedics and periosteoplasty as was originally described by Drs Millard and Latham. All cases were carefully documented through adolescence, including clinical assessments, orthodontic, radiographic, and cephalometric analyses. In 1998, in this journal, we published our data on 35 complete unilateral and 10 complete bilateral cleft patients. At that time facial growth was following normal cephalometric patterns. Crossbites were dental and treated with orthodontics. There was radiologic evidence of bone within the alveolus with elimination of the oronasal fistula, and facial aesthetics revealed soft faded scars and balanced noses.

That publication was a preliminary study with the intent to provide long-term results when full facial growth was achieved. This article reports on 25 patients from the initial cohort (20 unilateral and 5 bilateral) that we were able to closely follow up for 25 years, with the same clinical team, making it the longest study of its kind. At this stage, data revealed continued growth of the midface both vertically and horizontally. Secondary alveolar cleft bone grafting when required was in small aliquots placed into well-healed tissue, and orthodontic movement of teeth was through a consolidated alveolus. Orthognathic procedures were performed in 2 of 5 bilateral and 0 of 20 unilateral cases.

We concluded that in this cohort, dynamic maxillary orthopedics and periosteoplasty, despite controversy in the literature, did not negatively impact facial growth and provided the benefit of early structural normalization and social integration by consolidation of the maxilla, closure of the oronasal fistula, tension free closure of the lip, and by balancing the nose.

Key Words: cleft lip and palate, cleft lip, cleft palate, maxillary orthopedics, periosteoplasty, gingivoperiosteoplasty, latham appliance

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Clefting deformities, although varied among ethnic groups, occur in approximately 1 in 800 births, creating physical and psychosocial challenges for the patient, and family, and cleft team[1–4] (Fig. 1). Decisions made in the newborn period are often revealed in later years.

In 1985, the senior surgeon on this team (F.L.), dissatisfied with the current state of cleft care, sought a different approach. The concept of early structural normalization of the face with a consolidated, aligned dental arch, elimination of the oronasal fistula, a tension free closure of the lip, and a balanced nasal base was appealing. Our team began to follow the protocols of Drs Ralph Millard and Ralph Latham using dynamic maxillary appliances (DMA) and mucogingivoperiosteoplasty (GPP),[5] even though their early data published in 1990 was met with controversy espousing the creation of dental cripples and mid face deformities.[6] We assembled a database of 35 unilateral and 10 bilateral complete cleft patients and published our 13-year experience in The Annals of Plastic Surgery 1998.[7]

This was among the first of longer-term evaluations. Our data correlated well with that of Cutting et al[8] demonstrating bone in the consolidated cleft (Fig. 2), arch alignment (Fig. 3), balanced faces, and normal cephalometric growth patterns (Fig. 4) into adolescence. All cephalometric analyses were within 2 standard deviations of normal. What was needed to abate the controversy regarding midfacial growth was a continued study into adulthood. In this paper we were able to follow and treat 20 unilateral and 5 bilateral cleft patients form our original cohort. These were not subselected but considered

FIGURE 1. Primary closure of the lip without orthopedics, resulting in severe structural and psychosocial ramifications.

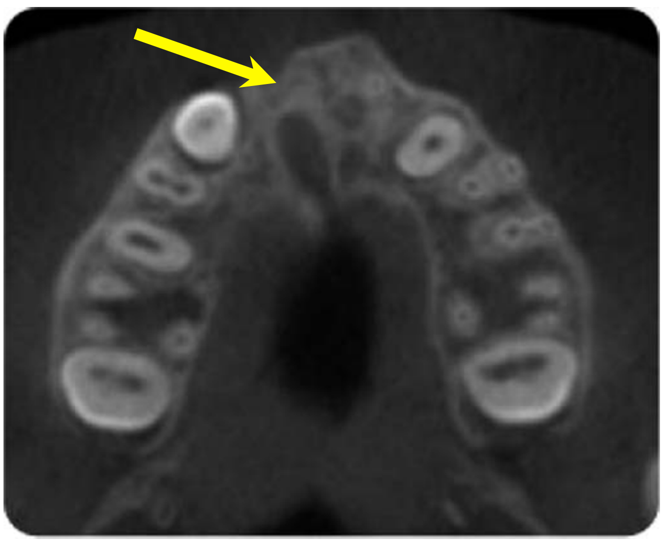

FIGURE 2. Evidence of bone consolidating the cleft maxilla.

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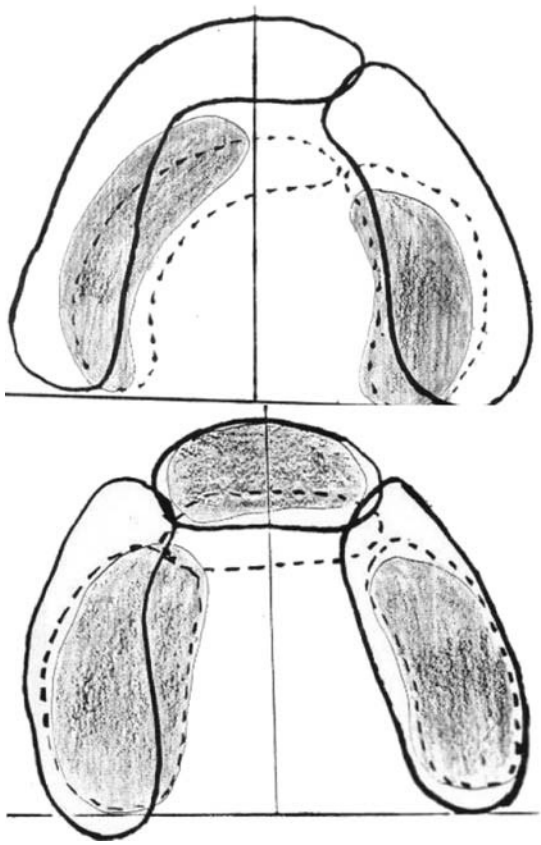

FIGURE 3. Serial occlusogram demonstrates pre- and post-DMA position of the maxillary arches. Shaded area represents original cleft position; dotted lines represent post-DMA repositioning; bold lines represent growth and expansion over time.

random as they represented those we were able to keep track of over course of time, accepting inherent patterns in mobility and geographic, social, and familial changes.

METHODS

All 45 patients in the original group were treated with the same protocol. At birth, static prostheses were made to stabilize the cleft alveolar segments and allow for the casting of the DMA, which were pin fixated in the operating room at 6 weeks of age (Fig. 5). After approximately 12 weeks of slow progressive movements, the arches aligned (Fig. 6), allowing for closure of the entire primary palate using a Millard 2 rotation advancement procedure with GPP. The secondary palate was closed at 1 year with a Von Langenbach technique (Fig. 7).[9]

Patients underwent speech therapy with home parental support and in formal settings as soon as cooperation allowed. Early orthodontic care guided the teeth into position and secondary alveolar bone grafting if needed was performed before permanent tooth eruption. Nasal tip work if needed was performed before entering primary school and cephalometric analyses were performed in adolescence and again at skeletal maturity. Psychosocial support with cleft parenting groups was integral.

RESULTS

The initial study into adolescence[7,8] demonstrated that early intervention with DMA and GPP provided complete closure of the primary palate at approximately 12 weeks with elimination of the oronasal fistula, normal arch alignment, and balanced noses and lips that were easily closed (Fig. 8). Only 1 patient required pharyngeal flap surgery for velopharyngeal insufficiency. We believe this consistency relates to the maxillary orthopedics helping to align the hard and soft palate for tension free closures.

Although bone was present in the fused alveolar segments, some additional support was needed and was delivered into a healthy recipient bed with small amounts of bone and bone morphogenic protein. Because no secondary flaps were required for closure of a fistula, "bone take" was excellent. Occlusograms showed normal forward growth patterns and were confirmed by cephalometric studies. Dental arch crossbites were lateral and were managed with orthodontics.

The 25 patients followed into adulthood were cephalometrically and aesthetically reevaluated upon skeletal maturity using cephalometrics for orthognathic surgery appraisal system, which considers dental, skeletal, and soft tissue variations[10] (Fig. 9). In the unilateral group, 7 of the 20 met mathematical criteria for consideration of orthognathic surgery. None of the 7 proceeded and were instead treated with rhinoplasty and fat grafting to the midface, pyriform and lip. In the bilateral group, 4 of the 5 patients met cephalometric criteria for surgery but only 2 consented. The others were similarly treated with nasal and fat grafting procedures (Fig. 10). Our oral surgeon reported that in those who underwent corrective jaw surgery, it was easier to perform with a consolidated one-piece maxilla.

Although familial and ethnic characteristics played a role in surgical decision making, it was the severity of the cleft and labiopalatal deformity that truly indicated who underwent corrective jaw surgery.

DISCUSSION

Cleft surgeons continue to debate the hot button topic of midfacial growth disturbance and the implications that DMA and GPP were contributory to the point that the need for orthognathic surgery was viewed

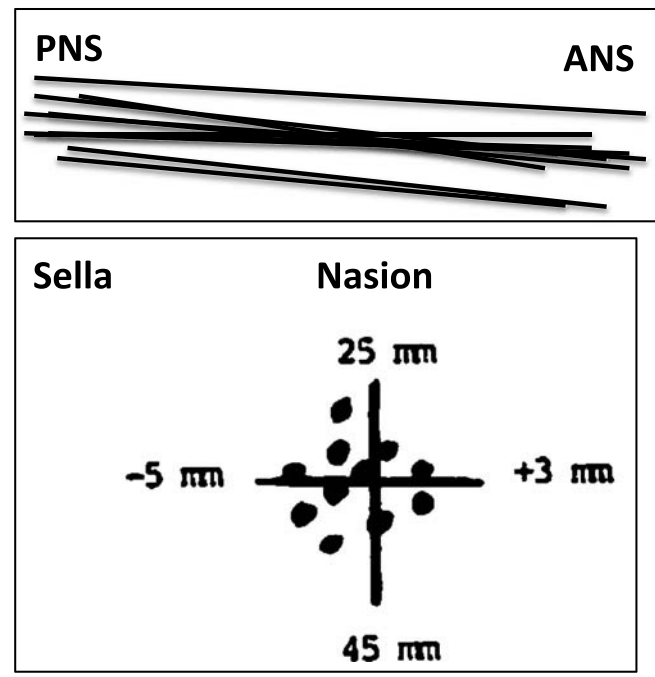

FIGURE 4. (top) PNS-ANS normal value for control group of adolescents (mean, 12 years) 52.6 mm standard deviation 3.5 mm. All patients were within 2 SD of normal. (bottom) Sella-nasion normal value for adolescents (mean, 12 years), 76.9 mm; SD, 3.0 mm. All patients within 2 SD (5.0 mm maximum deficient) and 1 SD (3.0 mm excessive).

FIGURE 5. Dynamic maxillary appliances to create a unified and balanced infrastructure, with the goal to align the alveolar segments, close the oronasal fistula, and provide for a tension free closure with a balanced lip and nose. Bilateral and unilateral appliances demonstrated.

as a treatment failure.[6,11,12] Therefore, most centers have moved away from pin-fixated prosthesis with periosteoplasty and are using nasoalveolar molding followed by secondary bone grafting as their standard treatment algorithm.[13]

However, the literature is dotted with studies in support of maxillary orthopedics and primary GPP.[14,15] In 1997 and 1998, respectively, Drs Wood, Grayson, and Cutting, and Lukash compared patients with and without primary GPP and were unable to demonstrate any clear impairment of maxillary growth.[7,8] Wang et al[16] reported a 72% success with primary GPP and only 28% requiring secondary bone graft. And, when secondary alveolar bone grafting was still required after GPP, it was technically easier with less graft substance required.[13] Birgfeld and Roberts[17] refer to primary GPP as the "holy grail" in cleft care in attempts to eliminate what most patients refer to as the most painful memory of cleft repair—the graft from the hip.

We are in agreement with other authors that the need for orthognathic surgery cannot always be predicted and is influenced by the severity of the cleft and labiopalatal deformity at birth.[18] An article championed by Mulliken out of Boston[19,20] concluded that the severity of the cleft and not the techniques for closure determined the outcome (reporting that roughly 49% of their unilaterals and 76% of bilaterals needed corrective jaw surgery), and the Kawamoto group at UCLA felt that the need corrective jaw surgery should not be considered a failure of initial treatments but rather a consequence of the deformity and part of the treatment algorithm.[21] The cephalometric analysis in our study

FIGURE 6. (top) Bilateral and (bottom) unilateral pre and post-DMA molds.

FIGURE 7. (top) Unilateral, (bottom) bilateral. Pre-DMA (left), post-DMA (middle), and after closure (right). By age 3 months the aligned primary palate was completely closed and by 1 year the secondary palate was repaired thereby diminishing the cleft stigma.

was pure and did not account for familial or ethnic variables, which may account for mathematically positive patients declining surgery. Again, our oral surgeon reported that the corrective jaw surgery was technically easier with a consolidated one-piece maxilla.

We live in an era of increased social pressure. It is known that the psychological stress involved in parenting a cleft child often begins before birth and can continue for a lifetime.[1,7,22,23] The feedback from parents regarding the use of DMA was positive. It is our experience that the proactive management of CL/P using dynamic cleft maxillary appliance initiated at birth with early primary GPP helps to alleviate parental distress as they can watch the cleft segments move into alignment. As the cleft segments began to align so did their feelings that their child was going to be "normal."

CONCLUSIONS

The authors of this article are not out to challenge or thwart the contemporary data in cleft research, rather we set out to discuss our own experience following Dr. Millard's technique, and to open the door for continued conversation on cleft care optimization.

Currently, there is tremendous inconsistency in the literature regarding data collection, analysis, and reporting, especially regarding the use of infant orthopedics and DMA. After 25 years of patient care, the ultimate question we set forth to ask; did we help or did we hurt? In asking this question, it is important not to loose sight of our goal for early normalization and social integration of infants and families with cleft lip and palate. Initially, we were met with resistance and concern that our practice would create midface cripples; however, our long-term results revealed successful subjective normalization with limited need for additional surgery.

The common notion that successful cleft lip and palate surgery eliminates the need for future jaw surgery is a flawed model. We openly discuss orthognathic surgery with our patients and introduce it early as a part of the algorithm. Our main goal of this longitudinal review was to return the emphasis back towards early normalization and social integration, and show that our groups' practices did no harm.

FIGURE 8. (top) Unilateral, (bottom) bilateral. Representative photographs at adolescence with structural and socially acceptable facial balance.

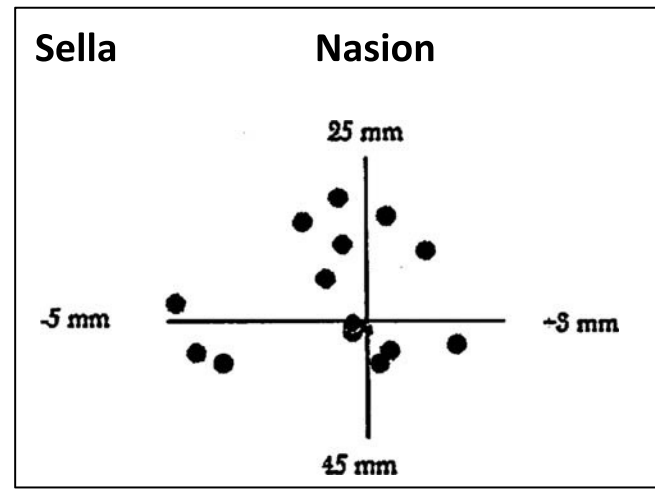

FIGURE 9. Sella-nasion normal value unchanged for adult 76.9 mm SD 3.0 mm. Cephalometric follow-up into adulthood demonstrated consistent forward maxillary growth in most cases.

FIGURE 10. (left) Bilateral cleft lip and palate patient after corrective jaw surgery, (middle) bilateral cleft lip and palate patient without corrective jaw surgery. (right) Unilateral cleft lip and palate without corrective jaw surgery.

We have concluded, in our cohort of patients, DMA and infant GPP did not adversely affect long-term outcomes. We believe that this early structural normalization leads to better social integration of the family unit and peer interactions at school, as evidenced by our close interpersonal follow up as well as through various social media platforms. We consider orthognathic surgery when indicated to be part of the accepted management for cleft lip and palate patients, and not a failure of treatment plan.

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