PATIENTS WITH CLEFT LIP AND PALATE ARE BEST TREATED IN A MULTIDISCIPLINARY SETTING. THERE IS EVIDENCE THAT PATIENTS BENEFIT FROM CARE PROVIDED IN CENTERS THAT HAVE HIGHER VOLUMES OF PATIENTS. 1-5

PATIENT CARE IMPROVES FROM THE COLLECTIVE EXPERIENCE OF MEMBERS OF THE TEAM WHO PROMOTE A UNIFIED APPROACH IN THE BEST WAY TO NORMALIZE THE LIFE OF A CHILD WITH A CLEFT. 6

ONE CHALLENGE LIES IN THE MANAGEMENT OF THE PALATAL CLEFT, DENTAL ARCH, AND SUBSEQUENT MAXILLARY FORM. 7-9 MANY CENTERS OFFER PROTOCOLS EMPHASIZING DIFFERENT APPROACHES IN SURGICAL TECHNIQUE, TIMING OF INTERVENTION, AND ORTHODONTIC CONSIDERATION. 9-15 OFTEN THESE CENTERS WILL HAVE DIFFERENT SURGEONS USING DIFFERENT TECHNIQUES AND THEREFORE PRESENT A LESS HOMOGENOUS EXPERIENCE. 16,17

THERE IS A PAUCITY OF LITERATURE EXAMINING LE FORT I OSTEOTOMIES PERFORMED BY A SINGLE SURGEON. 18-22 THE PURPOSE OF THIS STUDY WAS TO PRESENT THE EXPERIENCE OF A SINGLE SURGEON (K.E.S.) WHO HAS TREATED MORE THAN 2000 PATIENTS WITH CLEFT LIP AND PALATE AT THE INTERNATIONAL CRANIOFACIAL INSTITUTE (ICI). WE PRESENT THE SENIOR AUTHOR’S PROTOCOL IN APPROACHING MAXILLARY GROWTH AND PROVIDE A CONSECUTIVE 8-YEAR REVIEW OF A CONVENTIONAL MAXILLARY ORTHOGNATHIC SURGERY PERFORMED AT GROWTH COMPLETION.

WE REVIEWED LONG-TERM RESULTS AND COMPLICATIONS OF THE LE FORT I OSTEOTOMY IN THIS COHORT OF PATIENTS. WE EXAMINED AN APPROACH TO ALVEOLAR AND PALATAL FISTULAS, THE PREMAXILLA, AND RELAPSE. THE EMPHASIS IS ON THE DELIVERY OF TOTAL CARE WITH A LARGE NUMBER OF THE PATIENTS HAVING BEEN OPERATED ON BY THE SENIOR SURGEON (K.E.S.) SINCE BIRTH AND EXPOSED TO THE SAME PROTOCOL.

METHODS

Between 1997 and 2004, 103 consecutive patients with complete data and a diagnosis of nonsyndromic cleft lip and/or palate who underwent Le Fort I osteotomy by the senior author (K.E.S.) were identified. Patients with incomplete records were excluded from the study.

Demographics

Retrospective data was collected looking at demographics (age and sex), preoperative diagnosis, and length of follow-up. Patients who had a follow-up less than 12 months were excluded.

Previous Surgery

The initial surgeon who repaired the cleft lip and/or palate and the orthodontist who helped plan the surgery were identified. If the initial surgery was performed by the senior author (K.E.S.), the total number of procedures related to the cleft deformity was reported. History of orthognathic surgery or distraction osteogenesis procedures was also noted.

Preoperative Examination

The preoperative presence of fistulas and, in the case of bilateral cleft lip and palate (BCLP), premaxillary mobility were also noted.

Operative Details

The operative data regarding the number of maxillary bony segments advanced, the anteroposterior advancement distance, and the adjunctive procedures were reviewed.

Postoperative Assessment

Postoperative assessment included correction of fistulas, premaxillary stability, perioperative complications, incidence of relapse (measured by clinical assessment of overjet and overbite), and finally, reoperative rate.

PROTOCOL

The protocol at the ICI involves the following:

1. Palatoplasty

   Two flap palatoplasties 23 performed at 9 months of age. The alveolar cleft, if present, is not surgically manipulated.

2. Pharyngoplasty
In the case of bilateral clefts,

Patients will have an ongoing clinical review with a speech therapist. Nasendoscopy and video fluoroscopy are used to assess the portal and the requirement for surgery.

3. Bone grafting

Bone grafting of the alveolar cleft is performed in the early mixed dentition when two thirds of the canine root is developed. Cancellous bone from the iliac crest is used in conjunction with a dental splint for stability in all cases.24 In the case of bilateral clefts, the premaxilla is osteotomized and the creation of a single, stable maxillary arch is the goal.

4. Distraction osteogenesis

Patients in early adolescence who have emerging severe Angle class 3 malocclusion will be assessed in a combined clinic for a Le Fort I distraction procedure. The choice of a distraction technique is discussed with the family, although the preferred techniques use a rigid external system. The family is advised that this intermediate procedure does not avoid a more definitive procedure at growth completion.

5. Orthognathic surgery

Growth completion is assessed by the orthodontic team through clinical examination and radiographic assessment (including hand-wrist radiographs). The goal of treatment planning is to create a projecting face and orthognathic profile. Most treatment plans incorporate maxillary surgery. Isolated sagittal split mandibular surgery is uncommonly performed. If a small palatal fistula persists, it is dealt with in a 1-stage operation together with the Le Fort I maxillary advancement. Two- or 3-piece maxillary advancements are performed to treat persistent palatal fistulas and transverse maxillary deficiency or to accomplish differential segmental movements (Tables 1 and 2).

### TABLE 1. Orthodontic Protocol

<table>
<thead>
<tr>
<th>Patient Age/Stage of Development</th>
<th>Orthodontic Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 wk</td>
<td>Passive infant appliance</td>
</tr>
<tr>
<td>5.5–8.5 y</td>
<td>Palate expansion</td>
</tr>
<tr>
<td>7–9 y</td>
<td>Preparation for bone graft</td>
</tr>
<tr>
<td>5–10 y</td>
<td>Face mask &lt;4 mm, class 3</td>
</tr>
<tr>
<td>Mixed dentition</td>
<td>Routine orthodontics</td>
</tr>
<tr>
<td>14–16 y, 30% unilateral and 40% bilateral</td>
<td>Final treatment, perisurgical orthodontics</td>
</tr>
</tbody>
</table>

### TABLE 2. Surgical Protocol

<table>
<thead>
<tr>
<th>Patient Age/Stage of Development</th>
<th>Surgical Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 mo</td>
<td>Primary repair of the cleft lip and nose</td>
</tr>
<tr>
<td>8 mo</td>
<td>Two-flap palatoplasty</td>
</tr>
<tr>
<td>5 y (35% of the patients)</td>
<td>Secondary minor lip and nose surgeries</td>
</tr>
<tr>
<td>7–9 y (100% of the patients)</td>
<td>Cancellous iliac bone graft to the alveolar cleft site(s)</td>
</tr>
<tr>
<td>7 y, full growth</td>
<td>Distraction osteogenesis in selected severe cases, &gt;12 mm, class 3</td>
</tr>
<tr>
<td>Full growth, 30% unilateral and 40% bilateral</td>
<td>Orthognathic surgery</td>
</tr>
<tr>
<td>8–18 y</td>
<td>Rhinoplasty, other soft tissue surgery</td>
</tr>
</tbody>
</table>

### TABLE 3. Preoperative Patient Demographics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total patients</th>
<th>Male</th>
<th>Female</th>
<th>Age, mean (range)</th>
<th>Unilateral cleft palate</th>
<th>Bilateral cleft palate</th>
<th>ICP</th>
<th>Follow-up, mean range</th>
<th>Total number patients in whom the senior author (K.E.S.) performed an initial cleft surgery at infancy</th>
<th>Total number of patients planned with the same orthodontist</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

### TABLE 4. Demographics of Patients With UCLP

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total patients</th>
<th>Patients with initial surgery performed by K.E.S.</th>
<th>Mean No. operations to reach growth completion</th>
<th>No. maxillary segments</th>
<th>No. maxillary segments</th>
<th>Prior maxillary surgery</th>
<th>Distraction osteogenesis</th>
<th>Orthognathic surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.5</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>2 pieces</td>
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<td></td>
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<td></td>
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<td>3 pieces</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prior maxillary surgery</td>
<td></td>
<td>Distraction osteogenesis</td>
<td>Orthognathic surgery</td>
</tr>
</tbody>
</table>

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FIGURE 1. Unilateral cleft lip and palate: patient M.A. was treated by K.E.S. since birth and underwent primary left cleft lip repair at age 3 months, cleft palate repair at age 8 months, pharyngeal flap at age 7 years, cancellous bone graft to the alveolar cleft site at age 9 years, and maxillary Le Fort I advancement with pharyngeal flap advancement at age 17 years. A, Patient M.A. at age 20 days (frontal view); B, at age 20 days (lateral profile view); C, at age 10 years (frontal view); D, at age 10 years (lateral profile view); E, dental and occlusal photos at age 16 years and before orthognathic surgery (frontal, frontal smile, and lateral profile views); F, dental and occlusal photos at age 17 years and after orthognathic surgery (frontal, frontal smile, and lateral profile views); and G, lateral cephalometric radiographs at age 9, 16, and 17 years.
If the maxilla requires differential movement or widening, then controlled osteotomies are created after down fracture with a reciprocating saw. A fine burr is used between the diverging roots of the teeth. The orthodontist will facilitate the osteotomy by angling the dental roots distally or mesially.

Patients are routinely placed into heavy intermaxillary elastics at the completion of the procedure and then transferred into the surgical intensive care unit for overnight monitoring. A nasal trum pet, a nasogastric tube, and a urinary catheter are used for optimal patient monitoring. These monitoring devices are removed before transfer to the ward floor.

RESULTS

Preoperative
Fifty-nine male and 41 female patients were seen and evaluated at the ICI with an age range of 15 to 41 years (mean age, 18 y; Table 3).

Fifty-four patients had a UCLP, 46 had a BCLP, and 3 had an isolated cleft palate (ICP). Follow-up ranged from 12 to 110 months (mean, 26.2 mo). In 44 of the cases, the senior author had performed the initial cleft surgery at infancy.

All except 5 cases were planned with the same orthodontist. Team meetings were conducted on a monthly basis to discuss cases and to plan for upcoming surgeries.

The cleft and craniofacial team at the ICI includes a cranio facial surgeon, a pediatric neurosurgeon, a pediatric anesthesiologist, a neuroradiologist, a pediatric intensivist, a neuro-opthalmologist, a pediatric ophthalmologist, an otolaryngologist, an orthodontist, a pediatric nurse, a speech pathologist, a geneticist, an orthotist, anthropologists, a pedodontist, a psychologist, and a social worker.

Unilateral Cleft Lip and Palate Cases
Of 54 patients, 20 had initial surgery performed by K.E.S. Each patient had a mean of 4.5 operations to reach growth completion (Table 4; Figs. 1A–G).

Number of Maxillary Segments
Forty-one cases were 1-piece maxillary movements, 10 were 2-piece maxillary movements, and 3 were 3-piece maxillary movements.
**Previous Maxillofacial Surgery**

One patient had previous distraction osteogenesis, and 2 patients had orthognathic surgery performed at another institute.

**Preoperative Fistulas**

Nine patients had alveolar fistulas, 4 had palatal fistulas, and 2 had combined alveolar/palatal fistulas. Of the 9 alveolar fistulas, all were found to be closed on postoperative examination. Three of the 4 palatal fistulas were found to be effectively closed on postoperative examination. One patient required an additional operation to close the palatal fistula. One of the 2 combined alveolar/palatal fistula cases was found to be closed at postoperative evaluation. A small palatal fistula persisted postoperatively in the other patient (Table 5).

**Planned Maxillary Movements**

The mean planned horizontal advancement was 8.6 mm (range, 4–15 mm).

**Complications**

A single complication arose in this group of patients with a postoperative bleed requiring return to the operating room to obtain hemostasis. The patient did not require transfusion.

---

**TABLE 5. Unilateral Cleft Lip and Palate Fistula Audit**

<table>
<thead>
<tr>
<th>Type of Fistula Evident Preoperatively</th>
<th>Primary Surgery Performed by K.E.S.</th>
<th>Fistula Successfully Closed After Orthognathic Surgery</th>
<th>Patient Referred to K.E.S. After Primary Surgery Performed by a Different Surgeon</th>
<th>Fistula Successfully Closed After Orthognathic Surgery</th>
<th>Fistula Totals Upon Preorthognathic Surgery Examination</th>
<th>Total Fistulas Successfully Closed After Orthognathic Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>18</td>
<td>21</td>
<td>39</td>
<td>9</td>
<td>9</td>
<td>9</td>
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<tr>
<td>Alveolar</td>
<td>0</td>
<td>9</td>
<td>39</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Palatal</td>
<td>1</td>
<td>1</td>
<td>39</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Combined</td>
<td>1</td>
<td>1</td>
<td>39</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total patients with UCLP</td>
<td>20</td>
<td>34</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Bilateral Cleft Lip and Palate Cases

Of 46 bilateral cleft palate patients, 23 had the initial surgery done by K.E.S., and each of this group had a mean of 7.1 operations to reach growth completion (Table 6; Figs. 2A–G).

Number of Maxillary Segments

Thirty-eight cases were 1-piece maxillary advancements, 4 were 2-piece maxillary advancements, and 4 were 3-piece maxillary advancements.

Previous Maxillofacial Surgery

Six patients had previous distraction osteogenesis procedures performed by K.E.S. Of these 6 patients, 5 were followed up by K.E.S. since birth. At the time of orthognathic surgery, none of these patients had any evidence of fistulas, the premaxillas were stable,
and all underwent 1-piece Le Fort I surgery. The mean horizontal advancement was 7.2 mm.

None of these patients experienced perioperative complications, and none required additional operations. One patient ended up with edge-to-edge occlusion but declined further corrective surgery.

**Preoperative Fistulas**

One patient had evidence of an alveolar fistula, 8 had palatal fistulas, and 2 had combined alveolar/palatal fistulas on preoperative assessment. The 1 alveolar fistula was found to be corrected on postoperative examination. Of the 8 palatal fistulas, 3 were closed with the Le Fort I procedure, 2 required an additional procedure to close the fistula, and 3 had persisting fistulas that the patients declined to have operated on. The 2 combined cases were determined to be closed on postoperative evaluation (Table 7).

**Planned Maxillary Advancement**

The mean planned advancement was 8.3 mm (range, 4–12 mm).

**Complications**

Two perioperative complications were noted in this group of patients. Both complications were superficial infections that led to failure of palatal fistula closure and relapse, requiring a second Le Fort I osteotomy.

Three patients developed gingival recession.

<table>
<thead>
<tr>
<th>Type of Fistula</th>
<th>Evident Preoperatively</th>
<th>Primary Surgery Performed by K.E.S.</th>
<th>Fistula Successfully Closed After Orthognathic Surgery</th>
<th>Patient Referred to K.E.S. After Primary Surgery Performed by a Different Surgeon</th>
<th>Fistula Successfully Closed After Orthognathic Surgery</th>
<th>Fistula Totals Upon Before Orthognathic Surgery Examination</th>
<th>Total Fistulas Successfully Closed After Orthognathic Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>17</td>
<td></td>
<td>18</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alveolar</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Palatal</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total No. patients with BCLP</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Mobile Premaxilla**

Seven mobile premaxilllas were noted preoperatively. All surgeries in this subgroup were uncomplicated. Six of the cases resulted in a stable premaxilla postoperatively. One required a separate surgical procedure to regraft the maxilla, which resulted in complete bony union.

**Isolated Cleft Palate Cases**

Three patients were noted, all of whom had their initial surgery done by K.E.S. Each had a mean of 2 operations to get to growth completion. All were 1-segment maxillary Le Fort I advancements. None of these patients experienced complications, and none required reoperation (Table 8).

None of the ICP patients had previous maxillofacial surgery, and no fistulas were present.

The mean advancement in the anteroposterior plane was 5.7 mm (range, 4–8 mm).

**Total Cases**

The following are the total type of maxillary Le Fort I osteotomy procedures (Table 9): 1-piece maxillary advancement, 82 cases; 2-piece maxillary segmental advancement, 14 cases; and 3-piece maxillary segmental advancement, 7 cases.

Nine 2-piece and two 3-piece advancements were performed for fistulas that were present, in which case modified incisions were invariably used and iliac crest bone was grafted to the site.

In some cases, controlled osteotomies were required to alter the transverse width of the maxilla or to facilitate differential movements. In these cases, modified incisions were not used but careful dissection of attached gingiva was permitted to allow adequate exposure for interdental osteotomies. Five 2-piece advancements and five 3-piece advancements were performed in this way.

<table>
<thead>
<tr>
<th>No. Maxillary Segments</th>
<th>UCLP</th>
<th>BCLP</th>
<th>ICP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 piece</td>
<td>41</td>
<td>38</td>
<td>3</td>
<td>82</td>
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<td>2 pieces</td>
<td>10</td>
<td>4</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>3 pieces</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>46</td>
<td>3</td>
<td>103</td>
</tr>
</tbody>
</table>
TABLE 10. Fistula Closure Assessment

<table>
<thead>
<tr>
<th>Fistulas Upon Initial Presentation</th>
<th>Fistulas Repaired at Time of Orthognathic Surgery</th>
<th>Patients That Required Separate, Delayed Fistula Repair Procedures, Successfully Closed</th>
<th>Persisting Fistulas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alveolar</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Palatal</td>
<td>12</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Combined</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

No teeth were damaged in any procedure, and 99% of the procedures resulted in a stable arch form. As mentioned previously, one case required regrafting to stabilize a postoperatively unstable premaxilla.

**SPEECH**

All patients received a preoperative nasendoscopy to assess the portal for intraoperative planning and prediction of function after the operation.

Six patients had their pharyngeal flap divided before surgery without sequelae to the velopharyngeal function. Four patients had their flap advanced, and 1 patient had an intraoperative flap procedure performed.

Two patients required pharyngeal flaps postoperatively (and did not have them before the maxillary Le Fort I advancement).

**ADJUNCTIVE PROCEDURES**

Fifty-four patients had onlay demineralized bone placed to augment the zygomatic prominences. Fifty-one patients had bilateral sagittal split osteotomies of the mandible, 32 had genioplasty procedures, 24 had inferior turbinate resections, 7 had buccal fat excision, and 1 had liposuction of the neck (Table 10).

The fistula repair rate with maxillary Le Fort I advancement surgery was 77%. A further 2 fistulas required an extra procedure to close a persistent fistula, bringing the fistula repair rate, at completion of all surgeries, to 85%. Alveolar fistulas were consistently closed, but palatal fistulas were more difficult to redress especially in the bilateral cleft population.

Four percent of the patient population had a persistent palatal fistula at the end of all surgeries. All patients were offered further surgery to correct the deformity. However, all patients declined additional surgical interventions.

**RELAPSE RATE**

Thirteen patients displayed relapse. All relapses were clinically evident within a year of follow-up. Because of significant relapse, 9 patients underwent a repeated orthognathic surgery to successfully correct the deformity.

Results were statistically analyzed, and there were no significant variables, although the presence of preoperative fistulas approached significance ($P = 0.11$).

**Unilateral Cleft Lip and Palate**

Five patients (10% of those with unilateral cleft lip and palate [UCLP]) developed relapse with recurrence of negative overjet/overbite. Of these 5 patients, 3 had repeated orthognathic procedures. The remaining 2 patients accepted the less-than-ideal edge-to-edge occlusion.

**Bilateral Cleft Lip and Palate**

Eight patients (17% of those with BCLP) displayed evidence of relapse, of which 6 required repeated Le Fort I procedure and 2 accepted the relapsed occlusion.

**REOPERATIVE RATE**

Eleven percent reoperative rate was noted. Two patients required further operations to close the fistulas. One patient required an operation to close a fistula, graft a mobile premaxilla, and correct a relapse. Eight patients required an additional procedure for relapse alone.

Seven of the reoperated patients had BCLP.

**DISCUSSION**

To professionals involved in cleft patient care, the challenge lies in the aims of function and appearance, balancing the goals of care. Every intervention has a repercussion often not seen for years. The benefit of experience from years of applying a single protocol is clear, so is the vigilance needed to publish data reflecting ones experience with the same protocol. Often, repercussions of surgical intervention may not be identified until after growth completion and a specific protocol has been implemented many times. It is here where a review of the publication of data not only shows the craniofacial surgeon what to do but, just as importantly, what not to do.

No more is this seen than in the assessment of maxillary growth and the effect of intervention during growth. We examine a group of patients who had Le Fort I osteotomies by a single surgeon, a little under half of which had been operated on since birth by the same surgeon, and all of whom had been exposed to the same treatment protocol.

Our demographics reflect the referral practice of the senior surgeon with a high proportion of bilateral cleft palates compared with other series. This is the most difficult of the subgroups to look after, with a higher incidence of fistulas, premaxillary considerations, vascular supply, and surgical access issues. There was also a relatively low incidence of ICP in our cohort with only 3 cases in the consecutive population.

The cleft subgroup demonstrates higher relapse than other patients undergoing orthognathic surgery. The goal of our protocol was to create a stable dental arch to enable one segment maxillary advancement whenever possible if orthognathic surgery was required. Eighty-nine percent of cases where K.E.S. was the original surgeon were completed as a 1-piece osteotomy. Although modifications are used to enable procedures to incorporate fistulas, unstable dental arch forms, and mobile premaxilllas, our preference was to coordinate a 1-piece movement whenever possible. However, wherever there were occlusal benefits or preoperative alveolar fistulas, segmental surgery was performed successfully.
Previous authors have shown that relapse is noted within a year of surgery, and our findings concur with this.\textsuperscript{25} The amount of maxillary advancement does not seem to correlate with relapse.\textsuperscript{22,26,27} The incidence of fistulas was very low in the UCLP group followed up since birth. However, this was not reflected in the BCLP group and indicates the more difficult management problems that the BCLP group embodies.

The fistula repair rate compares favorably with other reports, especially given the high proportion of bilateral cases in this series. The incidence of premaxillary stability postoperatively, the creation of a stable dental arch, and the surgical dental gap closure was 99%. This high success rate reflects the efficacy of the Le Fort I orthognathic procedure to allow dental gap closures, fistula repair, and stable advancement.

Speech outcomes were affected in only 2 of our patients. Based on preoperative assessment, pharyngeal flaps in place were either divided or advanced. One patient had an intraoperative flap performed. Our usual course is to warn patients of possible changes in velopharyngeal function and discuss the possible need for an additional postoperative procedure. Despite division of 6 flaps intraoperatively to facilitate advancement, we did not see deterioration in velopharyngeal function. Similar findings have been observed in other studies.

The fundamental treatment objectives in orthognathic surgery are function, stability, and aesthetics. Adjunctive procedures are performed to produce the best aesthetic result for the patient. If during preoperative planning a large maxillary advancement is anticipated (>15 mm), then a concomitant mandibular setback is performed. The goal is to create a projecting face and orthognathic profile wherever possible. Paying careful attention to the balance and proportion between various facial structures, other helpful adjunctive procedures include advancement genioplasty, onlay demineralized bone grafting to augment cheek prominences, buccal fat excision, and liposuction. Although inferior turbinate reduction is often performed at the time of maxillary Le Fort osteotomy, any dedicated or extensive septorhinoplasty is deferred to a later, additional procedure. We do not believe strongly that a rhinoplasty needs to be delayed until after growth completion or definitive jaw surgery, especially if there is a major deformity of the nose causing psychological harm.

A minority of patients who display severe developing class 3 malocclusion in early adolescence will be candidates for early distraction osteogenesis procedures. The mean maxillary advancement in this group was 7.9 mm, with no evidence of relapse or reoperation. We believe distraction osteogenesis to be an effective technique in creating facial projection while often reducing the extent of orthognathic surgery required at growth completion. Distraction osteogenesis is not used as replacement of conventional orthognathic surgery techniques at growth completion.

The overall reoperative rate is comparable to other studies. Two patients required repair of fistulas, and 9 had further operations due to relapse. Any patient with relapse in occlusion was offered a second surgery. The goal is to create a perfect occlusion with stable function. The requirement to achieve this goal sometimes necessitates an additional smaller surgery, which produces a result that is inherently more stable. Of the reoperated procedures, all have successfully maintained proper overjet and overbite relationships. We believe that the higher reoperation rate may be skewed in our study because of the higher proportion of bilateral cleft cases, which are technically more demanding.

Orthognathic surgery can be performed successfully in the cleft population.\textsuperscript{28–30} We advocated single-segment maxillary Le Fort I orthognathic surgery when we began performing orthognathic surgery in the early 1970s. At that time, we used wire fixation, and internal rigid fixation did not exist. At that time, single-segment advancement gave the most stable result. The majority had a relapse, and we planned a 20% overcorrection. We continued the 1-piece maxillary concept until more recently when we frequently started using a 4-piece maxillary Le Fort osteotomies with internal semirigid fixation with improved stable results and ease of leveling the occlusion. This is not reflected in this cohort. A protocol embracing bone grafting in mixed dentition and repair of fistulas before growth completion facilitates a less complicated future orthognathic surgery. However, if presented with unstable dental arches, fistulas, or differential movements, a modified Le Fort procedure can be safely undertaken with excellent results. Reoperating due to relapse should be recognized and provided as necessary. The satisfaction of being able to provide complete care to a patient from birth to adulthood is a most rewarding aspect of cleft lip and palate care.

REFERENCES

Irish children with unilateral cleft lip and palate treated with different primary surgical techniques. Cleft Palate Craniofac J 2004;41:42–46

2009 Mutaz B. Habal, MD

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