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Aesthetic Plastic Surgery

A New Face by Combined Surgery for Patients with Complex Dentofacial Deformity

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Abstract
Background: This article aims to present and discuss 53 patients who received a new identity because of major changes to the face after treatment with bimaxillary osteotomy, concomitant maxillomalar augmentation, genioplasty, and rhinoplastic procedures for their complex dentofacial skeletal deformity and class 3 malocclusion.
Methods: During a 12-year period (January 1993 to April 2005), more than 500 patients with dentofacial deformities and malocclusions have undergone orthognathic surgery performed by a team consisting of the same plastic surgeons and orthodontists. Among this group, 53 patients (30 women and 23 men) underwent surgery for both aesthetic and functional concerns. The mean patient age was 20.4 years (range, 17–28 years). All the patients were treated with bimaxillary osteotomy, concomitant maxillomalar augmentation, osseous genioplasty, and rhinoplastic procedures in the same session. The patients were followed 12 to 44 months by the plastic surgeon, and at least 1 year by the orthodontist.
Results: There was no orthognathic relapse or other major complications requiring reoperation. There was prolonged nerve anesthesia or hypoesthesia that resolved within 6 months for 4 patients (7.5%), a short period of anesthesia or hypoesthesia that resolved within 4 weeks for 11 patients (20.7%), a wide alar base in 3 patients, and a slight deviation of the cartilage septum in 2 patients.
Conclusion: In one session, five different procedures can be performed without any problem, each of which can produce major changes to the face while maintaining the whole facial harmony. The authors determined that these dramatic positive outcomes for the combined procedure can easily be tolerated and accepted by all their patients. However, the patients have had difficulty with their family or friends accepting their new appearance, and even have had to change their photos on identification cards. This is encouraging for the management of new patients in the future.
Key words: Bimaxillary osteotomy—Complex dentofacial deformity—Concomitant maxillomalar augmentation—Genioplasty—Rhinoplasty

Patients with facial disharmony frequently have abnormal nasal shapes and complex dentofacial skeletal deformities with varying degrees of malocclusion. Most patients with malocclusion and face skeletal deformity not only are functionally disturbed, but also are usually very much disturbed by their external appearance. Orthognathic surgery, using a coordinated surgical and orthodontic approach to correct skeletal deformities and malocclusion, has gained increasing acceptance in recent years. Some benefit has been achieved through an early start and long periods of orthodontic intervention to avoid surgery.

The usual method for correcting skeletal deformity or severe dentoalveolar deformity, however, is bimaxillary osteotomy associated with other procedures performed in the same session, including maxillary and zygomatic augmentation, genioplasty, rhinoplasty, or some other cosmetic procedure. Preoperative orthodontic preparation and postoperative orthodontic adjustment have an important role in obtaining a stable, satisfactory, occlusal result and a pleasing face [2,5,10]. Rigid fixation after bimaxillary

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osteotomy has improved patient comfort, has allowed the use of additional procedures to refine the aesthetic outcome further, and has created more demand for surgical treatment. For patients with facial complex skeletal deformity in addition to malocclusion, the extent of surgery can range from simple bimaxillary osteotomy to complex bimaxillary procedures concomitant with augmentation surgery, genioplasty, and rhinoplasty.

Orthognathic surgery and rhinoplasty frequently have an important place in the correction of facial deformity. The nose is a prominent midline structure, always on display, and consequently of paramount importance in facial aesthetics. An abnormal nasal form may give rise to significant psychological morbidity for many individuals, making rhinoplasty one of the most commonly performed cosmetic surgical procedures.

Abnormal jaw relationships also can be responsible for facial disharmony, in both full-face and profile views. Few surgeons routinely perform orthognathic surgery simultaneously with other aesthetic procedures in one stage due to the unpredictability of soft tissue movement and the potential for causing unfavorable results [1,5,8,11,14,22,23,25,31,37].

Individual experiences with the combined complex approach and new surgical techniques allow plastic surgeons to make specific changes to skeletal structures, usually with satisfactory aesthetic and functional results. This article aims to present 1 to 5 years of clinical and cephalometric follow-up evaluation for 53 patients treated with simultaneous bimaxillary osteotomy, concomitant maxillomalar augmentation, genioplasty, and rhinoplastic procedures for their complex dentofacial skeletal deformity and class 3 malocclusion.

Materials and Methods

During a 12-year period (January 1993 to April 2005), more than 500 patients with dentofacial deformities and malocclusions have undergone orthognathic surgery performed by the same team of plastic surgeons and orthodontists. Of this group, 53 patients underwent surgery for both aesthetic and functional concerns. Patients who had undergone previous cleft lip–palate surgery and trauma were excluded from the study.

All 53 patients (30 women and 23 men) had long-face syndrome characterized by vertical maxillary excess, maxillomalar deficiency involving a flat midface, mandibular prognatizm, vertical excess of the chin, depressed nasolabial area, smooth labiomental area, lip incompetence, and frequently a narrow nose and excessive upper incisor show. The mean patient age was 20 years. Four patients ranged in age from 17 to 28 years.

The soft tissue prediction displayed in profile view by the computer was discussed with all our patients. They were told that this was an estimated profile view only for observing the appearance of their new faces, and that the essential goal was based on facial harmony for each step of the combined facial surgery. All were treated with simultaneous bimaxillary osteotomy, concomitant maxillomalar augmentation, osseous genioplasty, and rhinoplastic procedures (Table 1). The frequency of directional maxilla movements were as follows. Combined anterosuperior movement was required for 43 patients, averaging 6 mm (range, 4–13 mm) and 6.5 mm (range, 2–11 mm), respectively. Maxillary advancement for 10 patients averaged 7 mm (range, 5–11 mm).

Table 1. Overview of the treatment characteristics

Procedures performed orthognathic	No. of cases
Maxilla	
Advancement and intrusion	43
Advancement	10
Mandible	
Sagittal-split osteotomy and setback	53
Chin	
Vertical shortening and advancement	21
Advancement	5
Sliding advancement	21
Vertical shortening	6
Maxillo-malar augmentation	
Silicon	40
High-density porous polyethylene (Medpore)	6
Allograft rib cartilage	5
Authogenous bone graft	2

Maxillomalar augmentation was performed with silicon implants (40 cases), high-density porous polyethylene (Medpore) (6 cases), allograft rib cartilage (5 cases), and autogenous bone grafts (2 cases). All the patients underwent surgery for mandibular setback ranging from 4 to 12 mm via a modified sagittal split osteotomy. For eight patients with a setback exceeding 9 mm, a portion of bone was resected from the posterior part of the distal segment. Osseous genioplasty using a saw and burr was performed for 53 patients. Six patients underwent only reduction with horizontal osteotomy. Vertical reduction and advancement with horizontal osteotomy was performed for 21 patients who had shallow, effaced labiomental folds. Five patients with shallow folds underwent advancement with horizontal osteotomy. Advancement and upper rotation with oblique osteotomy was performed for 21 patients with shallow folds. The degree of advancement achieved by genioplasty varied from 3 to 7 mm. All the patients underwent rhinoplastic procedures over septoplasty, including standard rhinoplasty for 16 patients (Table 2).

The patients were followed up for 12 to 44 months by the plastic surgeons, and at least for 1 year by the orthodontist. Lateral cephalometric radiographs were taken using a position of centric occlusion with the

Table 2. Rhinoplasty procedures

	No. of cases
Standard rhinoplasty	16
Other procedures	37
Alar reduction	33
Cartilage grafts	37
Columellar	2
Supratip	5
Combined	30
Septoplasty and septal resection	37
Inferior turbinate surgery	15
Hump reduction	32
Bony augmentation only	3

lips relaxed. Frontal and lateral photographs were obtained in the immediate preoperative period. These studies were repeated at the time of follow-up assessment, after an average of 19 months.

Surgical Technique

The surgical procedures followed a sequence of Le Fort I osteotomy, maxillomalar augmentation, mandibular sagittal split osteotomy, genioplasty, and finally rhinoplasty. Each patient underwent bimaxillary surgery with rigid internal fixation. For 43 of the cases, twice consecutive Le Fort I osteotomy was performed to allow for the planned intrusion. For the remaining 10 patients, the maxilla was downfractured after only Le Fort I osteotomy. Care was taken to close the nasal mucosa. The maxilla was oriented to the mandible using an intermediate splint prepared at the time of model surgery. After intermaxillary fixation, the maxilla was stabilized with four L-shaped titanium miniplates and screws.

All the materials used in the maxillomalar augmentation were formed to the shape of the individual facial deformity for each patient perioperatively. These materials were inserted primarily in an anteromedial position with the extension left short on the zygomatic arch area and placed a little medially to the infraorbital nerve 2 to 3 mm above the osteotomized level. Fixation was achieved with two screws in each augmentation material. Bony grafts used for augmentation were harvested from vertical shortening of the chin and the proximal fragment of the mandible. Nasal alar base width was controlled by the alar base cinch suture. Incision closure then was completed with V-Y closure of the lip.

A bilateral modified sagittal split osteotomy of the mandibular rami was performed, with care taken to avoid inferior alveolar nerve damage. A rotational pry using a fiber-handled 10-mm osteotome was made between fragments at the inferior and particularly the posterior border of the rami to relax the periosteum. Disturbance to the position of the condyle during the movement of the setback can be avoided by splitting the segments totally free with the help of this maneuver. The proximal and distal segments of the mandible were rigidly fixed to each other in position and in an uncompressed fashion using three bicortical screws per side via a transbuccal approach after attachment of the occlusal splint. Then, articulation of the condyles and the occlusion were evaluated. Intermaxillary fixation was applied for as long as 2 weeks to guide the maxilla and mandible into the new occlusion position.

Finally, genioplasty was performed, with mucosal incisions placed at least 8 to 10 mm superior to the labial sulcus. Immediately down from the insertion of the mentalis muscle, periosteal dissection was used. Osteotomies were passed at least 5 mm below the mental foramina because the mental nerves are lower in the mandible before they ascend and exit. Fixations in the osteotomized genioplasties were achieved, usually with two long screws, and rarely, with two plates and four screws.

With completion of the orthognathic procedures, the nasal endotracheal tube was changed to an oral endotracheal tube, and rhinoplasty was performed. Rhinoplasties were performed via the closed approach, using intercartilaginous and intranasal rim incisions. When cartilage grafts were required, they often were obtained from the septal cartilage. In addition to the soft tissue adjunctive procedures, such as nasal cinch suturing and a V-Y closure, a transfixion suture was used. While the apex of the nostrils was being retracted superiorly with the help of a double-arm hook, a 3/0 chromic catgut matrix suture was placed in the very deep part of the nostril base (the medial edge of the base of the alar wings) for an additional support in all our cases (Fig. 1). After rhinoplasty, stabilization was provided by a small plaster splint. Bimaxillary osteotomy was performed, with maxillomalar augmentation, genioplasty, and rhinoplastic procedures performed in all 53 cases at the same sitting to improve facial harmony.

Results

The patients were followed for 12 to 60 months. The mean plastic surgery follow-up period was 19 months. All the patients were followed closely by an orthodontist for at least 12 months. It is known that the most frequent complications with orthognathic surgery are malocclusion, inferior alveolar nerve damage, and relapse. To date, no cases of relapse or other major complications requiring reoperation or long-term orthodontic therapy have been encountered. There was prolonged nerve anesthesia or hypoesthesia that resolved within 6 months in 4 cases (7.5%), a short period of anesthesia or hypoesthesia that resolved within 4 weeks in 11 cases (20.7%), a wide alar base in 3 cases, and a slight deviation of cartilage septum in 2 cases. The patients who had wide alar bases or deviations of the septum rejected

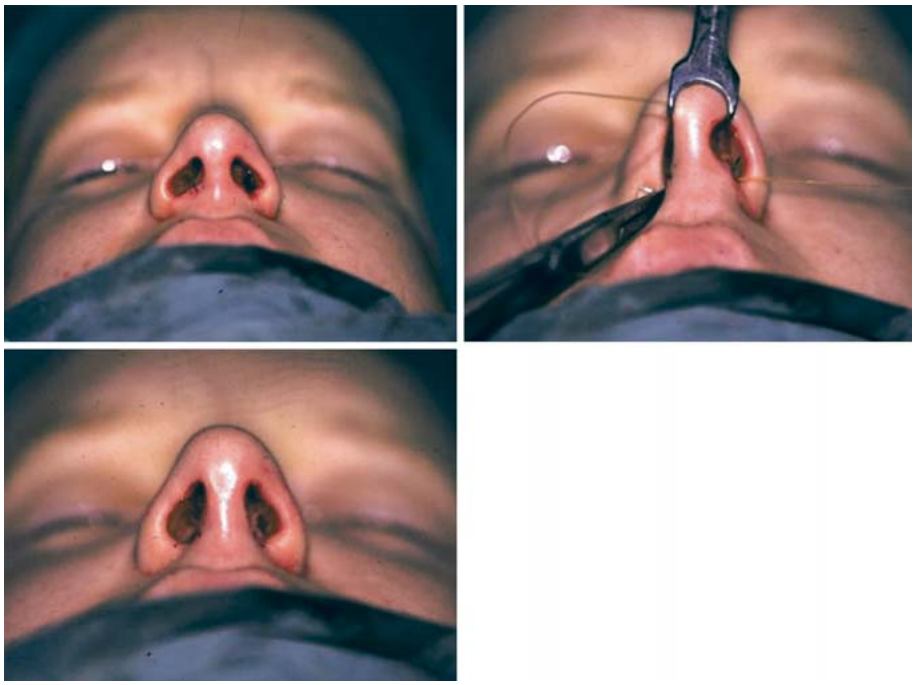

Fig. 1. Basal view of the nose after combined orthognathic surgery and before the rhinoplasty. Note the lowered columella, tip position, and base of the nostrils. The placement of the transfixation suture is shown. After placement of the transfixation suture and columellar strut, improvement in the columellar height, tip position, and base of the nostrils were seen.

recommendations for further nasal surgery. No other complications or unexpected results were encountered.

In this series, facial deformity and malocclusion were treated in every case without major complications. All that we planned before surgery was achieved in terms of facial harmony and oral function. Evaluation of the overall aesthetic improvement with subjective questionnaires or rating of the results on a scale by different clinicians or lay persons was possible [12,13,16,30]. However, patients' perceptions of the ideal aesthetic result are not always the same as those of clinicians. All our patients without an exception were satisfied with the results, although this observation can be regarded as speculative or subjective.

Case Reports

Case 1

An 18-year-old girl presented with long-face deformity and class 3 malocclusion. Her nasal abnormality consisted of a dorsal hump and a little tip ptosis. After the appropriate orthodontic preparation, a combined procedure was performed, which consisted of a Le Fort I maxillary osteotomy, bilateral mandibular sagittal split osteotomy, genioplasty, septorhinoplasty, and zygomatic augmentation (with silicon). Postoperative progress was unremarkable (Fig. 2).

Case 2

A 21-year-old boy had long-face syndrome. After the orthodontic preparation, a combined procedure was performed, which consisted of bimaxillary osteotomy (6-mm maxillary impaction and 6-mm advancement with Le Fort I osteotomy and mandibular setback with bilateral ramus sagittal split osteotomy), genioplasty, zygomatic augmentation (with silicon), and septorhinoplasty. He was very pleased with the result 2 years after the operation (Fig. 3).

Case 3

A 20-year-old girl presented with a class 3 malocclusion. After the appropriate orthodontic preparation, a combined procedure was performed, which consisted of a Le Fort I maxillary osteotomy, bilateral mandibular sagittal split osteotomy, genioplasty, standard rhinoplasty, and zygomatic augmentation (with silicon). She was very happy with her new appearance 18 months after the surgery (Fig. 4).

Case 4

A 19-year-old girl presented with complex dentofacial deformity. A combined procedure similar to those described in the preceding cases was performed (Fig. 5).

Discussion

Facial form is recognized by the skeletal framework and the overlying soft tissue. Although there are many imaging methods such as cephalometry, laser light scanning, ultrasound, computed tomography

Fig. 2. Note the remarkable difference between the preoperative and postoperative images. Advancement and intrusion of the maxilla, mandibular setback, vertical shortening of the chin, maxillomalar augmentation with silicon, and standard rhinoplasty using a closed approach were performed. Note the improvement in the gingival show on the smiling images.

(CT) scan, magnetic resonance imaging (MRI), and life-sized photos, the soft tissue-bone relations cannot be completely explored in facial skeletal surgery [6,18,19,21,28,34]. The beauty of the face is a result of the harmonious relation among the different sections. For an accurate description of the individual facial form, each region must be analyzed separately in concert with the entire face preoperatively and step by step during the operation. A functional deformity of the face can sometimes produce a change in the appearance of the face after surgery, making a second or concomitant surgery necessary. A patient with a flat midface, who may not need maxillomalar augmentation before an advancement of the maxilla, can require augmentation after the advancement. Similarly, a rhinoplasty can be required for compensation of the effects from the maxillary movements.

Sometimes, but not in every case, a combined procedure is unavoidable in terms of harmonizing the full face. Careful preoperative and perioperative evaluation of the patient is very important. Therefore, the quality of the judgment, the patience, and the skills of a surgeon (team) are the major limitations to these types of surgeries. These combined procedures can produce remarkable changes in the appearance of the face, even if not planned exactly. All the patients in this study got perioperative views that differed totally from their previous facial appearance. Approximately half (n = 21) of the 53 patients had to change their photos on their identity cards to avoid problems during their official lives.

Sometimes patients cannot tolerate the changes in their appearance after rhinoplasty alone, and the remarkable positive changes gained from the combined procedures may upset them. Many analyses to predict and reliably quantify the soft tissue response to maxillary and mandibular bony movements have been presented in the literature [4,17,24]. Sometimes

Fig. 3. Advancement and intrusion of the maxilla, mandibular setback, vertical shortening and advancement of the chin, maxillomalar augmentation with silicon, and septorhinoplasty using a closed approach were performed. A remarkable attractive change was achieved.

the definitive results of the soft tissue profile may deviate quite markedly from those expected, despite very careful planning. It is estimated that this unpredictability is naturally higher with combined orthognathic surgery. For this reason, few surgeons have performed or advocated the combined approach for the correction of facial deformity in one stage [3–9,16,30]. Therefore, the estimated appearance after combined surgery, sometimes with the help of computer-based stimulation as well as preoperation and postoperation images of previous patients, must be discussed. The patient should be told that this is an estimated profile view only for seeing how their new faces will appear. Patients should know that the essential goal is based on facial harmony during each step of the combined facial procedure.

Measurement of improvement rather than change in facial appearance is not only difficult, but also imprecise, and often can be described only in terms of relative change or change in relation to another face or group of faces. Therefore, any measurement, rating, or scoring of the facial appearance after surgery would not be sufficient for objective evaluation of the results [12,13,16,30]. Patients' satisfaction or dissatisfaction with the result is essential.

In general, the structure of the underlying bone dictates the malar prominence, and the degree of prominence of the malar area varies according to the ethnic bony structure. Examination for malar deficiency is not a totally objective analysis. However, standard measurements evaluating facial harmony and many other entities such as wide or narrow face,

Fig. 4. Impaction and advancement of the maxilla, mandibular setback, vertical shortening and advancement of the chin, maxillomalar augmentation with silicon, and standard rhinoplasty using a closed approach were done. A youthful face from an old appearance was achieved after combined procedures.

long or short face, thin or thicker skin, and even the age, weight, and height of the patient must be kept in mind for a more exacting analysis. In this study, the vast majority of the patients had a marked maxillomalar deficiency located solely in the anteromedial or both the anteromedial and posterolateral regions.

Maxillomalar deficiency may become more depressed after maxillary advancement with Le Fort I osteotomy. A small degree of maxillomandibular protrusion beyond normal limits may be considered attractive and pleasing, just as a small degree of flattening can be considered acceptable for the classic ''Apollonian'' face [36]. Therefore, patients undergoing maxillary advancement of 4 mm or more, who became part of this study, were evaluated and discussed for implants. We do not prefer to use modified Le Fort III or II osteotomies because of the potential for restriction of mobilization and some severe complications. Because the type of maxillomalar deficiency varies from patient to patient, all materials used in augmentations were formed to the shape of the individual facial deformity for each patient perioperatively.

A variety of methods are available for maxillomalar augmentation using autogenous or synthetic material. The choice of the material depends on the indications presented by each particular case as well as the preference of the patient and usually the surgeon. Autogenous materials including costal cartilage, costal bone, iliac bone, and cranial bone as an onlay graft are available for use in the maxillomalar region. However, the use of alloplastic materials (silicon and medpore) and allograft rib cartilage is preferred. Although the potential complication risk for alloplastic implants is migration, infection, extrusion, and erosion into underlying bone, they generally were used with good results. None of these complications were encountered. There was no evidence of noticeable resorption for five patients with the use of allograft rib cartilage or for two patients with the use of autogenous bone graft over short-term follow-up periods.

Satisfactory results were obtained for all the patients without any complications. Maxillomalar augmentation always achieved an attractive or satisfactory malar prominence that was in balance and harmony with the other facial features of all the patients.

The chin, like the nose, is in a prominent position on the face. For this reason, it must be assessed when any changes in the facial profile are planned [20]. Some authors have proposed systems for evaluating relative chin size and shape, but none of these systems are absolute [3,7,26]. Because the chin is advanced and/or reduced, the labiomental fold deepens, and the chin must not be advanced sagittally beyond the

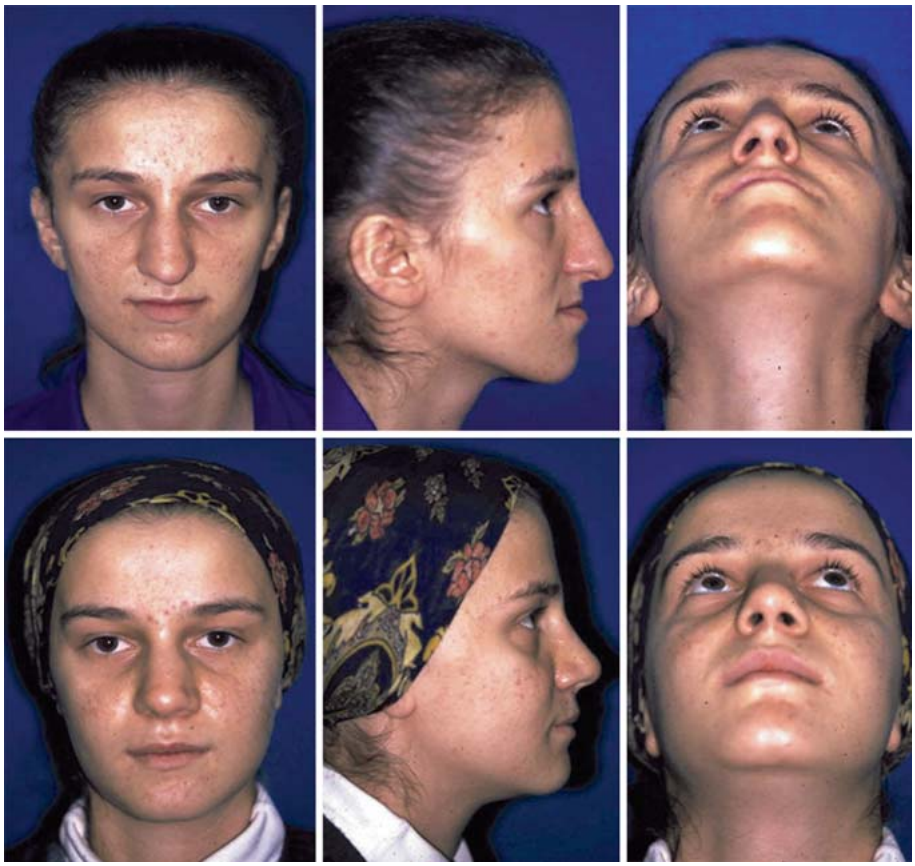

Fig. 5. Advancement of the maxilla, mandibular setback, sliding genioplasty, maxillomalar augmentation with silicon, and standard rhinoplasty using a closed approach were performed.

recessed position of the lower lip [27,35]. Because all the patients in our study had an increased lower face height, and/or flattened and effaced labiomental folds, vertical reduction and advancement or sliding advancement genioplasty was necessary. For some cases in which these deformities are considered mild or not severe, mandibular setback alone can be sufficient. Therefore, the genioplasty decision should be reevaluated perioperatively after the mandibular setback.

Orthognathic surgery and rhinoplasty have not routinely been performed concurrently, mainly because of the difficulty predicting the outcome of the soft tissue relationships and the potential for unfavorable changes to the nasal anatomy. With improved knowledge of the soft tissue response and with the development of techniques to control muscle position and soft tissue thickness, soft tissue changes have become more consistent and predictable. Previous articles have discussed combined orthognathic and rhinoplastic surgery and have shown good results [15,22,23,29,32,33].

Rhinoplasty is the last and the most important part of combined orthognathic surgery. The potential for causing favorable and unfavorable changes as well as functional changes to the nasal anatomy after Le Fort I osteotomy is to be expected. The preexisting deformity, the potential nasal changes after Le Fort I, the patient's expectations, and the surgeon's experience determine which rhinoplastic procedure is to be performed.

Our experience with about 500 orthognathic surgeries, more than 100 of which were concomitant with rhinoplastic procedures, shows that deformities of the nose involving the dorsum, nasal length, septal deviation, nasal tip width, and asymmetries will remain relatively unchanged after orthognathic surgery. However nasal tip position (tip projection−rotation) and nasolabial changes are greatly affected by maxillary surgery.

A minimized apparent dorsal hump and an elevated nasal tip after advancement and/or impaction of the maxilla should not mislead the surgeon. The nasal tip will tend to drop, and the dorsal hump will become apparent. To prevent this undesired misleading change, we have preferred to use a columellar strut (septal cartilage for the columellar strut is our preference) for tip support in a majority of our cases (60.4%). In addition to the soft tissue adjunctive procedures, such as nasal cinch suturing and a V-Y closure, we used a transfixion suture placed on the base of the columella for additional support.

With a nasal hump, supratip depression can be relatively accentuated by tip elevation, especially in maxillary advancement cases. A graft on the depressed area may be more necessary if rhinoplasty (dehumping) is not planned. We therefore believe that both the preoperative tip projection and the

nasal hump should be considered for evaluation of the supratip depression.

For a large advancement, with or without impaction of the maxilla, if there is good or even inadequate tip projection preoperatively, sometimes anterior nasal spine contouring may be needed. The bony support from the large advancement (> 4 mm) usually can provide adequate support for the tip projection.

If the maxilla is being superiorly and/or anteriorly repositioned (impacted and/or advanced), it is necessary to resect both the septum and the nasal crest of the maxilla to prevent septal deviation and buckling. A little touch of the septum on the crest is the criterion for the amount of resection. In the case of patients for whom advancement with a maxillary impaction of 4 mm or more is planned via a standard rhinoplasty, inferior turbinate reduction should be considered to prevent airway obstruction after surgery. In these cases, only tip plasty procedures may be suitable rather than reduction rhinoplasty.

We aimed to change rough faces to elegant, youthful, and attractive faces. Preliminary results for a combined composite approach used to correct deformities without rhinoplasty have been described previously by the senior author, and the current report illustrates that very good results can be achieved consistently [9].

In conclusion, five different procedures, each of which can produce major changes to the face while maintaining the harmony of the face as a whole can be performed in one session without any problem. We determined that these dramatic positive outcomes for the combined procedure were easily tolerated and accepted by all our patients even though their family or friends had difficulty accepting their new appearance and they sometimes had to change their photos on identity cards. We also should keep in mind and note that although this study encouraged us concerning new patients in the future, the results may not be accepted easily by the patients.

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