Aesth Plast Surg (2018) 42:1090–1100
https://doi.org/10.1007/s00266-018-1121-2



# Simultaneous Rhinoseptoplasty and Orthognathic Surgery: Outcome Analysis of 250 Consecutive Patients Using a Modified Le Fort I Osteotomy


M. Raffaini[1] · R. Cocconi[1] · G. Spinelli[2] · T. Agostini[2]

Received: 24 January 2018 / Accepted: 9 March 2018 / Published online: 20 March 2018


**Abstract**

*Background* The purpose of the present study was to assess the safety and efficacy of both functional intranasal procedures and cosmetic rhinoplasty combined with bimaxillary surgery.

*Methods* The author executed a retrospective cohort study derived from patients who underwent combined rhinoseptoplasty and bimaxillary surgery at a private practice setting (Face Surgery Center, Parma, Italy) between April 2006 and 2015 by a single surgeon. The minimum follow-up was 12 months. Patients underwent bimaxillary orthognathic surgery, functional nasal surgery and cosmetic rhinoplasty.

*Results* Two-hundred and fifty (250) consecutive, non-randomized patients met the inclusion criteria to enter the study. The overall complication rate was 5%, whereas the revision rate was 9%, showing an overall low rate, comparable to that of primary rhinoplasty (control group). About 94% of the patients polled after this procedure asserted they definitely accepted to have rhinoplasty only because it was included in one single surgical act together with orthognathic surgery.

*Conclusion* Cosmetic rhinoplasty shows great potentials to change our patients' appearance, whereas orthognathic surgery corrects jaw skeletal deformities and builds the right foundation for facial harmony. The combination of both procedures magnifies the single results reciprocally and significantly enhances the final outcomes. The quality of the overall aesthetic results, the scarcity of complications and the low percentage of defects that require revisions lead to the conclusion that when alterations to both the jaws and the nose are detected, a single intervention can grant great benefit to the patients in terms of morbidity and costs.

*Level of Evidence IV* This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

**Keywords** Orthognathic surgery · Cosmetic · Rhinoplasty · Functional nasal surgery · Septoplasty · Facial plastic surgery · Aesthetic · Facial reshaping · Nose job · Septoplasty · Turbinoplasty

## Introduction

Orthognathic surgery can be associated with ancillary procedures such as septoplasty, rhinoplasty and genioplasty. Orthognathic surgery and rhinoplasty are surgical procedures performed with functional and aesthetic purposes. Although some authors discuss rhinoplasty as an adjunct to orthognathic surgery, it is usually performed at least 6 months after bimaxillary surgery to reduce the risk of unfavourable results mainly linked to midface alterations after maxillary surgery, increased post-operative oedema and operative times [1–5]. Of course, the routine application of internal rigid fixation with plates and screws in the jaw thus eliminating the need for intermaxillary fixation facilitated the surgical approach to manage symptomatic chronic obstructive nasal breathing, as proved by an increasing number of papers on this topic [6–12]. So,

✉ T. Agostini
tommasoagostini@ymail.com

[1] Face Surgery Center, Via R. Bormioli 5/A, 43122 Parma, Italy

[2] Department of Maxillo Facial Surgery, Azienda Ospedaliero-Universitaria Careggi, Largo Palagi 1, 50134 Florence, Italy

if simultaneous procedures on maxillary bones and the nasal airway are somehow being described, no papers discuss, to the best of our knowledge, a simultaneous approach to the cosmetic correction of the nose in a large series of patients [10–12]. This prudent behaviour can be explained by some disadvantages arising with a traditional Le Fort I osteotomy, and they include: difficulty to assess the extent of nasal modifications following maxillary osteotomies; disruption of the nasal support system following the detachment of the pyriform ligament form the pyriform opening conjoint to the splitting of the cartilaginous nasal septum from the nasal spine-) soft tissue swelling of the lips, cheeks and paranasal area [13–22]. The aim of the present study was therefore to assess the safety, efficacy, advantages and disadvantages of rhinoseptoplasty performed at the time as orthognathic surgery using a modified Le Fort I osteotomy; then to compare the outcomes versus those obtained following delayed nasal procedures performed by the same author and finally to compare the results with those of the current literature on revision rhinoplasty to assess if these combined procedures are effective and with few complications.

## Methods

From 1991 to 2016, the senior author (MR) operated on 4230 patients using orthognathic surgery including bimaxillary surgery, mono-maxillary surgery, expansion of hard palate and segmentary osteotomies. Of these, 1045 patients (24.7%) underwent simultaneous orthognathic surgery and rhinoseptoplasty. Exclusion criteria included: incomplete preoperative and/or post-operative documentation, syndromic and post-traumatic patients and re-operative surgery both maxilla and/or nose. Thus, four hundred (400) consecutive, non-randomized patients underwent combined bimaxillary surgery and rhinoseptoplasty at a private practice setting (Face Surgery Center, Parma, Italy) between April 2006 and April 2015. The patients had no comorbidities influencing surgical outcomes, such as diabetes, obesity or other metabolic disorders, and were instructed to stop smoking at least 3 months preoperatively. Surgical procedures were carried out by the same senior surgeon (M.R.). All patients suffered dentoskeletal malocclusion (50% suffering malocclusion type II, 50% malocclusion type III), including nasal deformities requiring surgical management (congenital and post-traumatic deformities) (Table 1).

### Study Design

We retrospectively analysed the medical charts of 400 patients who underwent orthognathic surgery and simultaneous rhinoseptoplasty. The inclusion criteria were as follows: available preoperative standardized photographs, available preoperative and post-operative three-dimensional cone-beam computed tomography (CT) scans, and a minimum follow-up of 12 months. Finally, 250 patients aged 16–42 years (mean age 25 years) entered the study; 148 were female and 102 were male. All patients underwent proper orthodontic therapy and nasoendoscopic exploration before surgery, and none had previous surgical treatments. The patients involved in the present study complained of nasal obstruction to various degrees, and it was documented to be unresponsive to medical therapy by otolaryngologists. Suspected obstructive sleep apnea (OSA) patients were properly investigated by polysomnograms and pulmonologists. Patients suffering bi/mono-maxillary deformity of syndromic origin, previous septoplasty or rhinoplasty were excluded.

### Statistical Analysis

Statistical analyses were conducted using PASW, version 18.0 (IBM, Armonk, NY, USA). Descriptive statistics were represented as numbers and percentages or as means or ranges with standard deviations.

### Surgical Technique

This surgical procedure is carried out under general anaesthesia with nasoendotracheal intubation and balanced

**Table 1** Inclusion and exclusion criteria of the study design

| Inclusion criteria | Exclusion criteria |
|---|---|
| No comorbidities (diabetes, obesity, or other metabolic disorders) | Incomplete pre/post-operative clinical records |
| Minimum follow-up 24 months | Syndromic patients (Cleft, Hemifacial microsomia and other craniofacial malformation) |
| Pre/post-operative standardized photographs | Previous facial trauma |
| Preoperative 3D cone-beam computed tomography (CT) scans | Previous surgery of maxilla and/or mandible |
| Pre/post-operative cephalometric teleradiograph | Previous surgery of the nose |
| | Obstructive sleep apnoea syndrome (OSAS) |

hypotension. The whole dissection area is infiltrated with local anaesthetic and adrenaline (1:100,000). A minimally invasive 3-cm mucosal incision is performed with a low set electrocautery on the labial side of the vestibulum at 1 cm from the bottom. The submucosal dissection is then extended from one lateral to the other lateral incision for 1–2 cm; wider undermining was performed in case of posterior extended manoeuvres as for posterior impaction or downgrafting. Through this access, the labionasalis, the elevator labii superioris, the mirtiforme, the depressor septi nasi and the other muscular bundles which are inserted on the anterior maxilla are identified as a single sheaf, dissected with a scissors and finally sectioned, leaving a muscular stump of 2 cm wide and 1 cm long inserted on the bone. The anterior maxilla is exposed and the nasal spine is osteotomized from the maxilla with a sharp 12 mm osteotome, leaving 1 cm of the nasal spine connected with the septum and respecting a thin sling of the lower portion of the nasolabial muscle inserted on the spine itself (Fig. 1). After this subspinal osteotomy, the nasal mucosa is raised from the nasal floor with a periosteal elevator. The nasal septum is therefore laterally luxated on both sides to free it from the maxilla. The subperiosteal dissection of the maxilla is extended to the rear through a small lateral tunnel on each side. The aim is to limit the skeletal exposure to the surface strictly needed to perform osteotomy outlines. Subsequently a low-level Le Fort I horizontal osteotomy is marked with a reciprocating saw (The OsteoPowerTM System by Osteomed, Addison, TX, USA) with a 2-cm blade or, better, with an ultrasonic chisel (Mectron Medical Technology, ADC Dental, Bois d'amont, France). Posteriorly, the cut is orientated slightly downwards towards the maxillary tuberosity. The thin medial walls of the maxillary sinuses are cut as the reciprocating saw proceeds medially. Lateral osteotomies are completed in the posterior maxilla by driving a sharp, straight, 1.8 cm wide osteotome from the piriform aperture to the pterygomaxillary junction. A classic pterygomaxillary dysjunction from a lateral approach is always avoided. Instead, a straight osteotome is driven through the horizontal osteotomy from the pyriform bone crest back to the junction of the maxillary tuberosity to the pterygoid plates (Fig. 2). Then, once the osteotome is fixed at the pterygomaxillary junction and beneath the zygomatic buttress, it is rotated inwardly, thus provoking a downfracture of the maxilla [23]. A progressive controlled twist of the chisel leads to a sudden vertical separation of the maxilla from the pterygoid plates. Alternatively, the disjunction can be obtained by a spreader instrument inserted posteriorly after the initial anterior maxillary downfracture. When the pterygomaxillary disjunction is completed on one side, the same technique is replicated on the contralateral side in the same way. For complete mobilization of the maxilla, the palatine neurovascular bundles are released with the aid of an ultrasonic chisel. Maxillary repositioning and fixation proceed in the traditional fashion. After maxillary mobilization, the nasal procedures involving the nasal septum, turbinates and sinuses are easily accomplished through the oral approach, which allows for better control of the correction of the nasal airway using the appropriate technique. Care is taken to close the basal nasal mucosa to minimize post-operative bleeding. To set the nasal spine in its natural position avoiding septal distortion, it is imperative to prepare adequate room in the upper anterior maxilla with a bur, according to the tongue-in-groove principle (Fig. 1). The tip of the technique is the reconnection of the muscles sectioned. Indeed, the upper muscular end is sutured to the lower stump with 3–4 progressive independent 2 or 3 0 Vicryl sutures (Ethicon, Somerville, NJ, USA) proceeding from the deepest to the most superficial layer, and using a reabsorbable material. To obtain a better anchoring, it is preferable to fix some nostril base paranasal soft tissue to the upper maxillary borders with the first stitch, drilling a

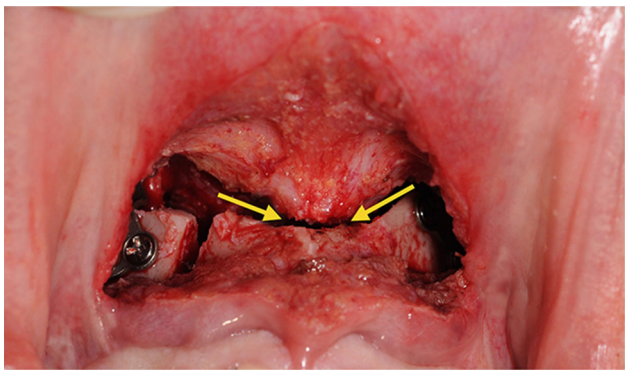

**Fig. 1** According to the tongue-in-grove principle, the nasal spine is isolated with the modified Le Fort I osteotomy and then repositioned in site after further remodelling following osteotomies

**Fig. 2** Osteotomy is driven through the horizontal osteotomy from the pyriform bone crest back to the junction of the maxillary tuberosity to the pterygoid plates

small hole. The following suture stitches are applied on the periosteum and then on the muscle layers. The mucosal suture without *W–Y* completes the access closure. The usual sequence begins with the orthognathic procedure performed under nasotracheal intubation with the jaws fixed with plates and screws to achieve solid skeletal structures. In the second step, the intubation is converted in an orotracheal intubation to allow the rhinoplasty procedure. The closed approach was preferred in case of limited dorsal deformity while the open approach in case of extensive nasal tip correction. Thus, rhinoplasty begins with septoplasty and turbinoplasty performed and lateral osteotomies initiated. All patients underwent change of intubation from nasotracheal to orotracheal through a second laryngoscopy, and re-intubation was uneventful in all cases. All patients were discharge the day after surgery. Most rhinoplasties were performed with an open technique (95%). The closed approach was reserved to patients suffering minor defects (exclusive hump reduction 2% or dorsal graft to fill a mild saddle nose 3%).

### Outcomes Assessment

An objective evaluation of the pre- and post-surgery facial appearances of each patient was performed by two surgeons, not involved in the study (a plastic surgeon and an otolaryngologist) and two orthodontists at the end of the follow-up period (12 months). Facial appearance was evaluated through clinical examination and analysis of photographs. In all cases, the clinical evaluation included the occlusal and aesthetic outcomes of the orthognathic surgery and the functional respiratory assessment (fibroscopy and preoperative/post-operative maxillo-facial CT scan comparison). Furthermore, an aesthetic judgment numerical scale, similar to the Wong–Baker FACES Pain Rating Scale [24] and the 11-Point Box Scale [25], was administered to the patients to determine whether they perceived post-operative improvements in their facial appearance. This scale was introduced recently by Funk et al. [26] as the Aesthetic Numeric Analogue scale (ANA Scale) for aesthetic assessment purposes. The ANA Scale is scored from 0 to 10, with 0 indicating no perceived aesthetic improvement ('insufficient') and 10 indicating the highest degree of perceived aesthetic improvement after surgery ('perfect').

## Results

### Operative Timing Analysis

Mean operative time of rhinoseptoplasty and orthognathic surgery was 197 min (range 124–276 min). Isolated orthognathic surgery required a medium time of 172 min (range 101–163 min), while primary rhinoseptoplasty required an average time of 95 min (range 90–126 min). Bone grafts, genioplasty and segmental maxillary surgery were ancillary procedures increasing the medium time of orthognathic surgery alone or conjoined to nose jobs. Intubation change from rhinotracheal to orotracheal required a mean time of 11 min (range 9–13 min). We never registered difficulties in airway management, which was managed by the operative surgeon with anaesthesiologists supervising.

### Post-operative Complications

We did not record major complications such as thrombosis or pulmonary embolism. Once discharged (usually after 24 h), patients were instructed to remain well hydrated and mobile to reduce facial oedema. We did not record wound infections. Two patients (0.4%) reported permanent numbness due to nerve damage. All patients received prophylactic antibiotics and pain medications. Patients typically returned to daily activities within 15 days following surgery, and post-operative oedema spontaneously resolved approximately 2 months after surgery. We did not record intranasal bleeding requiring nasal packing or respiratory distress requiring tracheostomy. All patients were monitored for at least 12 months. All patients underwent very good functional and aesthetic outcomes, and they were monitored with a conventional follow-up of 1, 3, 6 and 12 months. Some case examples are available in Figs. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18. At the end of the follow-up, patients received an anonymous questionnaire registering

**Fig. 3** A 16-year-old, class II malocclusion, with mandibular deficiency in a bi-retruded face. Rhinomegaly and crocked nose. Frontal view

**Fig. 4** A 16-year-old, dentoskeletal class II, with mandibular deficiency in a bi-retruded face. Rhinomegaly and crocked nose. Profile view

**Fig. 5** Post-operative control 9 years after surgery. He underwent combined rhinoseptoplasty and orthognathic surgery plus ancillary procedures (genioplasty). Frontal view

the rate of satisfaction that revealed 94% of patients definitely accepted to have rhinoplasty only because it was included in one single procedure.

## Outcomes Analysis

After orthognathic surgery, all patients had their dentoskeletal deformities corrected to a class I occlusion, and their chief complaint was fully addressed. According to the clinicians' evaluation, patients showed a noticeable post-operative facial aesthetic improvement: 227 patients (90.8%) received a top score (5—very beautiful with

**Fig. 6** Post-operative control 9 years after surgery. He underwent combined rhinoseptoplasty and orthognathic surgery plus ancillary procedures (genioplasty). Profile view

**Fig. 7** A 22-year-old woman with severe facial asymmetry and right mandibular hypoplasia (occlusal class II on the right and occlusal class III on the left) and deviated nose. Frontal view

remarkable improvement) and 23 patients (9.2%) were considered with evident improvement with mild irregularities and/or residual deformities (Fig. 19). The ANA Scale self-evaluation collected from the patients at 12 months post-operative showed that 245 had post-operative aesthetic outcomes (98%) satisfaction scores of 9 ('very satisfied'; 78%) or 10 ('beautiful; 20%)); 5 patients (2%), although not fully satisfied, expressed mild satisfaction: one patient as wished (7), two patients as satisfied (6) and two patients agreed (5). The self-evaluation satisfaction scores of all patients, according to the ANA Scale, are shown in Fig. 20.

**Fig. 8** Post-operative control after 3 years. She underwent conjoined bimaxillary 3D repositioning and centring (plus lip lipofilling) and rhinoseptoplasty. Frontal view

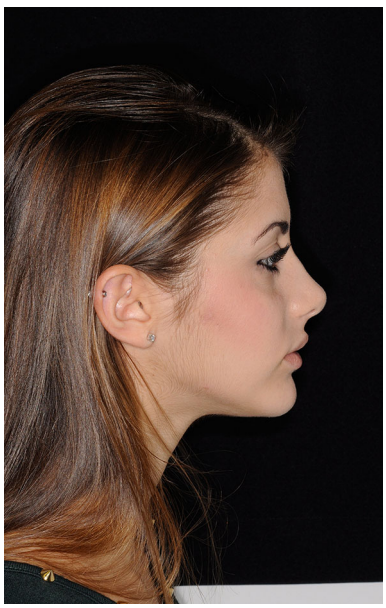

**Fig. 9** A 22-year-old woman with severe facial asymmetry and right mandibular hypoplasia (occlusal class II on the right and occlusal class III on the left) and deviated nose. Lateral view

## Discussion

### Comparison to Delayed Rhinoplasty

The complication rate for combined rhinoplasty was not dissimilar to the rates of rhinoplasty performed as an isolated procedure; in particular, residual nasal deformities such as 'polly-beak' deformity, saddle deformity and a residual dorsal hump were superimposable with respect to

**Fig. 10** Post-operative control after 3 years. She underwent conjoined bimaxillary 3D repositioning and centring (plus lip lipofilling) and rhinoseptoplasty. Lateral view

**Fig. 11** A 19-year-old woman. Mild facial asymmetry (L side fuller than the R). Moderate maxillary deficiency (CIII malocclusion), prominent chin, humped \nNose. Frontal view

the personal cases of the senior surgeon involving isolated nasal procedures (9.2 vs 6%). Twenty-three patients (9.2%) from the present case series experienced a single complication or a combination of them, including nasal dorsum irregularities (2%), residual nasal septum disease (2%), nasal tip deformities (4.8%), persistent respiratory limitation (4.3%) and internal nasal valve collapse (2.8%). To restore form and function, the 23 patients suffering residual complications underwent surgical revision including: nasal dorsum reshaping (1.2%), cartilage removal and

**Fig. 12** Post-operative control after 4 years. Bimaxillary advancement with clock-wise rotation (maxilla moved forward), rhinoseptoplasty and lip lipofilling, submental liposuction. Frontal view

**Fig. 13** A 19-year-old woman. Mild facial asymmetry (L side fuller than the R). Moderate maxillary deficiency (CIII malocclusion), prominent chin, humped nose. Lateral view

repositioning (0.8%), revision septoplasty (2%), turbinoplasty (0.8%), conservative nasal tip revision (5.2%), nasal tip revision with cartilage grafting (3.5%), spreader grafts (3.2%) and sectorial filling (4.8%). Of interest, we reported a lower percentage of patients suffering airway obstruction (2% of residual nasal septum deviation) although the overall complication rate is 9.2% for combined procedures versus 6% for isolated cosmetic rhinoplasty.

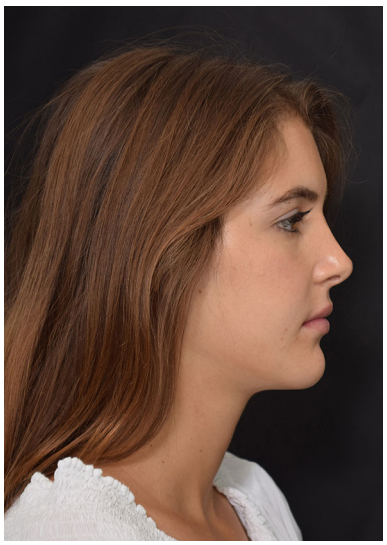

**Fig. 14** Post-operative control after 4 years. Bimaxillary advancement with clock-wise rotation (maxilla moved forward), rhinoseptoplasty and lip lipofilling, submental liposuction. Lateral view

**Fig. 15** A 22-year-old woman with class II malocclusion, prominent chin, mild maxillary excess, big, humped tension nose. Frontal view

## Comparison to the Current Literature

The complication rate for the nasal procedures performed with a Le Fort I osteotomy was minimal (9.2%) and not dissimilar to the rates reported for each procedure performed as an isolated event (6%). According to the current literature, several authors analysed the concerns of patients seeking secondary rhinoplasty. In a retrospective study of 100 secondary rhinoplasties, Constantian and co-workers found that the most common reasons for revision rhinoplasty were correction of a new deformity and failure to correct the original deformity [27]. Daniel et al. [28], in a prospective study, determined five reasons for revision

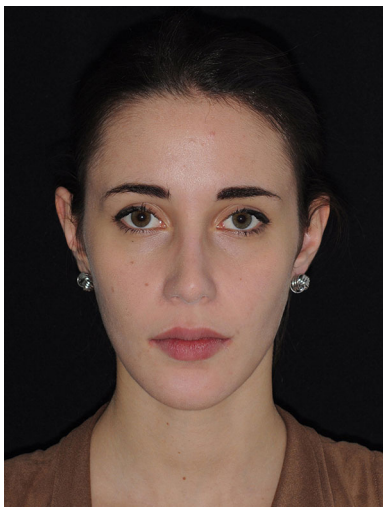

**Fig. 16** Post-operative control after 3 years. She underwent mandibular advancement, maxillary rotation, chin reduction, rhinoseptoplasty, lip and midface lipofilling. Frontal view

**Fig. 17** A 22-year-old woman with class II malocclusion, prominent chin, mild maxillary excess, big, humped tension nose. Lateral view

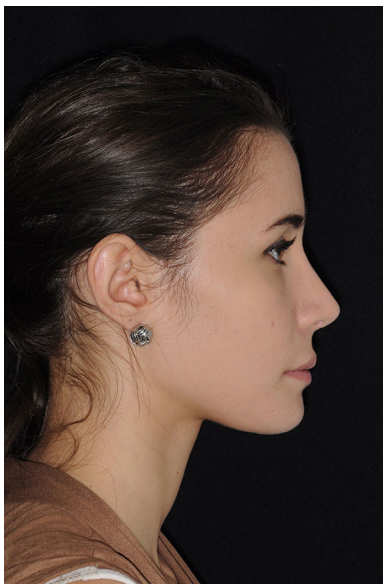

**Fig. 18** Post-operative control after 3 years. She underwent mandibular advancement, maxillary rotation, chin reduction, rhinoseptoplasty, lip and midface lipofilling. Frontal view

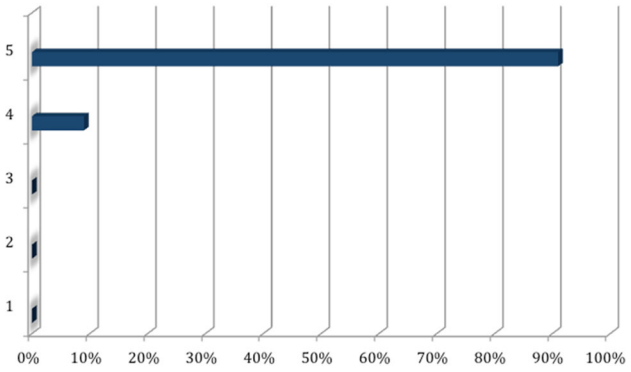


**Fig. 19** The clinicians' clinical assessment of aesthetic outcomes at the end of follow-up. The scale ranges from 1 to 5, with 1 indicating no aesthetic improvement and 5 indicating a major aesthetic improvement. 1—no noticeable improvement with some mild drawbacks; 2—no noticeable improvement; 3—moderate improvement with residual defects; 4—evident improvement with mild irregularities; 5—very beautiful with remarkable improvement

rhinoplasty: achieve a smaller nose, failure to correct the primary deformity, correction of a new deformity and elimination of the stigmata of rhinoplasty. Nassab and Matti [29] conducted a retrospective review of 109 consecutive secondary rhinoplasty patients in which septal deviation accounted for 32.1% as a cause of revision. According to a survey of rhinoplasty surgeons in the USA, 58% had revisional rates < 5%, whereas 33% had rates from 6 to 10% [30] and Guyuron and Bokhari [30] suggested the lower revisional rates may be attributable to an open rhinoplasty with better visualization. These data are consistent with multiple other studies in the literature as listed in Table 2. There continue to be high incidences of airway obstruction among secondary rhinoplasty patients because the majority of rhinoplasties are reductive in nature [30]. Hellings and Trenite [31] determined that 15% of patients presented functional problems and 30% presented a combination of aesthetic and functional concerns ($n$ = 43). Lee et al., in a study of 100 revisional rhinoplasties, found that 65% of patients presented some airway occlusion and septal deviation accounted for 29%, with an incidence of secondary rhinoplasty of 5–15% [30]. Yu et al. [32] reported an incidence of 61% of airway occlusion. Foda [33] reported 68% of airway occlusion ($n$ = 50).

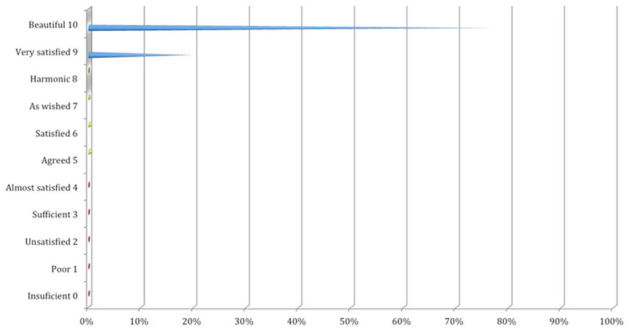


**Fig. 20** Patient satisfaction scores for aesthetic outcomes achieved at the end of follow-up (12 months after surgery). The score is based on the ANA scale, which ranges from 0, indicating an insufficient outcome, to 10, indicating a perfect outcome. 0, insufficient; 1, poor; 2, unsatisfied; 3, sufficient; 4, almost satisfied; 5, agreed; 6, satisfied; 7, as wished; 8, harmonic; 9, very satisfied; 10, beautiful

**Table 2** Data collected from the literature elucidating the percentage of airway obstruction following rhinoplasty

| Authors, year | Number of patients | % of airway obstruction |
|---|---|---|
| Yu et al. [32] | 104 | 61 |
| Constantian [27] | 150 | 70 |
| Fida et al. [33] | 50 | 68 |
| Thomson et al. [38] | 184 | 59 |
| Nassab et al. [29] | 100 | 42 |
| Heelings et al. [31] | 47 | 45 |
| Le et al. [35] | 10 | 65 |
| Bracaglia et al. [34] | 311 | 77.17 |

Constantian reported airway occlusion in 70% on revision rhinoplasty (105 of 150 patients) and Thomon and Mendelshon reported 59% on a sample of 184 patients [27, 34]. Of interest, we reported a lower complication rate of patients suffering airway obstruction (residual nasal septum disease 2%). This can be explained by the fact that lateral osteotomies medialize the upper lateral cartilage or/and the inferior turbinate thus narrowing the internal nasal valve. Although this effect can be prevented or corrected using spreader grafts or a conservative reduction of the inferior turbinates, the goal is to perform a high-to-low osteotomy, just above the inferior turbinates. This technical refinement can be easily performed during simultaneous procedures because the osteotomies begin at the time of orthognathic surgery with a better visualization.

## Goal of a Combined Approach

When osteotomies are carried out, they medialize the upper lateral cartilage, the inferior turbinate or both thus resulting in narrowing of the internal nasal valve with airway compromise and this ill effect is more emphasized with septal deviation, inferior turbinate hypertrophy or both. This is confirmed, indirectly, by the fact that septoplasty and turbinoplasty are the most common procedures performed in revision rhinoplasty [35]. The goal of a combined procedure (rhinoseptoplasty and orthognathic surgery) relies on three main topic: (1) patients undergoing a combined approach have complete radiologic documentation that allows proper diagnosis; on the contrary, patients undergoing rhinoplasty alone are not investigated for airway obstruction or are not treated due to the inexperience of the surgeons; (2) the open approach to the inner part of the nasal cavity permitted by the orthognathic surgery gives better visualization with several advantages included proper conservative reduction of the medialized turbinate, proper high-to-low osteotomy, proper caudal septal deviation management especially in the junction of the maxillary crest which is often removed during orthognathic surgery; (3) adequate prevention of septal deflection since subtle deviations of the perpendicular plate of the ethmoid and vomer bone may 'tent' the septal mucoperichondrium laterally, reducing the nasal patency [6]. The benefits are proven by our results that show a lower incidence and the results shown by Posnick [9].

## Limitations to Simultaneous Approach

Shortcomings to the present approach include the following: first, thin bones may be somewhat problematic both for bleeding (intraoperative/post-operative) and rigid fixation, thus increasing the risk during intubation change from nasal to oral and rendering it more convenient to delay cosmetic rhinoplasty. Second, if the senior surgeon was not sure about the occlusion (i.e. surgery first protocol), then septorhinoplasty was delayed. Third, extreme septal deviation with major functional problems requesting a total or subtotal cartilage rebuilding was indications for delayed nasal procedures. Finally, if the intraoperative bleeding was excessive/abnormal or rigid fixation was compromised or airway could be at risk, the nasal procedures were not carried out to avoid possible difficulty in case of emergency intubation and it was delayed at least 6 months. Bimaxillary surgery creates hard and soft tissue changes that may adversely affect the ability to assess the nose, and this is outdone by a meticulous preoperative planning in the hands of a surgeon with extensive expertise in orthognathic surgery [6]. In particular, deformities of the nose involving the dorsum, nasal length, septal deviation, nasal tip width and asymmetries will remain relatively unaltered following orthognathic surgery and for this reason they deserve focused surgical corrections [9]. On the contrary, nasal tip position including tip rotation, projection, and nasolabial changes are affected by bimaxillary surgery and they deserve accurate prediction. Of note, to avoid acute sinusitis due to the repositioned maxilla and obstruction of

the maxillary ostium, it is advisable to perform preventive bilateral opening of the maxillary ostium. Last, the present study represents a single-centre experience and exclusion of incomplete pre/post-operative clinical records can lead to selection bias.

### Overall Considerations

The classic Le fort I osteotomy mainly consists of creating a wide disruption of the muscular and ligamental insertion of the whole nasolabial unit, and consequent adverse changes can occur to the lip and nasal aesthetic subunit, including 1—widening of the alar nasal bases; 2—upturning of the nasal tip with a 'pseudo-saddle' nose effect; 3—upper and lower dislocation of the columella; 4—flattening, thinning and lengthening of the upper lip [1]. Hence, the reduction of soft tissue in this area results in changes similar to those seen with facial ageing, including deepening of the nasolabial groove, reduced vermilion, lateral retraction of the upper lip with downturning of the commissures [4, 5]. The soft tissue modifications are linked to the entity and extension of the subperiosteal dissection, muscular transection, handling of the musculature and mucosa during surgical access closure and finally to the direction of maxillary movement [3]. To avoid these changes, several methods of tissue repositioning and closure of the vestibular access have been described, but the main disadvantages of all these techniques rely on low predictably and variable results with inconsistency among published reports [4]. To prevent all unfavourable effects, a new outline cutting under the nasal spine has been proposed by many authors to respect the integrity of the nasolabial subunit [1]; furthermore, the novel osteotomy should be carried out at a lower level with respect to the teeth apex, with a 3-cm mucosal incision thus limiting the subperiosteal dissection while working in two lateral tunnels [1]. The aim is to perform a more conservative approach to the paranasal soft tissue, including ligaments and muscle. With the present technique, drawbacks of the nose and the upper lips have been almost eliminated and it allows a satisfying outcome in case of simultaneous septorhinoplasty as well. Advantages of combined bimaxillary and nose surgery include decreased pain due to hypoesthesia of the infraorbital nerve commonly present following bimaxillary surgery and a single procedure thus making surgery more attractive to patients who dread having to undergo staged procedures with multiple recoveries. In support of the present study, Waite and co-workers investigated 22 patients who underwent combined surgery and responded to a 1-year post-operative questionnaire revealing that 94% of them were pleased with the final result of orthognathic surgery, 84% were pleased with the result of rhinoplasty, 94% felt it was best to combined the two surgeries, and 78% of them would recommend this type of surgery to a friend. Of note, 16% of patients would have considered rhinoplasty as a separate procedure if it was not performed at the same time [10]. Recently, Berlin and co-workers investigated the short-term outcomes following orthognathic surgery alone and associated with ancillary procedures (septoplasty, rhinoplasty, genioplasty) in the USA from 1999 to 2011 [36]. They found interesting data that can be compared to the present single-centre study investigating the outcomes of orthognathic surgery combined with rhinoplasty. In particular, the total complication rate was 5.4% among the analytic cohort and it was higher in paediatric patients (< 18 years) that were more likely to experience complications with an extended length of recovery and increased costs and this point cannot be compared because we operated on patients older than 18 years. Similarly, although undergoing ancillary procedures was not associated with increased complications, it was associated with extended length of stay (20.8 vs 15.9%) and increased costs [36]. In the present series, the combination of orthognathic surgery and rhinoplasty did not increase the hospital stay, which was one night only (patients were discharged the day after). Finally, of interest, are the emerging data regarding the combination of orthognathic surgery and ancillary procedures: American colleagues perform orthognathic surgery combined with genioplasty in 12.5% of cases, with septoplasty in 4.4% and rhinoplasty only 0.8% [36]. As a consequence, it is evident that the association of bimaxillary surgery with ancillary procedures could be encourage in the light of the above results. A recently published article by Sun and Steinbacher, further supports simultaneous procedures with orthognathic surgery; the authors performed rhinoplasty and orthognathic surgery simultaneously in 12 patients without revision procedures during the follow-up of 18 months and with high self-reported satisfaction with functional and aesthetic results. Specifically, it has to be addressed that only 2 patients (16.7%) underwent bimaxillary surgery and the remaining 10 patients underwent monomaxillary surgery of the mandible. Hence, although Sun and Steinbacher encourage simultaneous procedures during orthognathic surgery, the present article provides evidence to their request for further studies including a large cohort of patients [37].

## Conclusion

Cosmetic rhinoplasty shows great potential for changing our patients' appearance, while orthognathic surgery corrects jaw skeletal deformities and builds the right foundation for facial harmony. The combination of both procedures magnifies the single results reciprocally and significantly enhances the final outcomes. The quality of the overall aesthetic results, the scarcity of complications and the low percentage of defects that require revisions

lead to the conclusion that when alterations of both the jaw and the nose are detected, a single intervention can grant great benefit to the patients in terms of morbidity and costs. The simultaneous correction of the nose and maxillary alterations can result in a well-balanced and harmonic face in a one-stage procedure with reduce morbidity and increased patient satisfaction.

**Acknowledgements** None of the authors has a financial interest in any of the products, devices or drugs mentioned in this manuscript.

## References

1. Carlotti AE Jr, Aschaffenburg PH, Schendel SA (1986) Facial changes associated with surgical advancement of the lip and maxilla. J Oral Maxillofac Surg 44(8):593–596
2. Guymon M, Crosby DR, Wolford LM (1988) The alar base cinch suture to control nasal width in maxillary osteotomies. Int J Adult Orthodon Orthognath Surg 3(2):89–95
3. O'Ryan F, Schendel S (1989) Nasal anatomy and maxillary surgery. I. Esthetic and anatomic principles. Int J Adult Orthodon Orthognath Surg 4(1):27–37
4. O'Ryan F, Carlotti A (1989) Nasal anatomy and maxillary surgery. III. Surgical techniques for correction of nasal deformities in patients undergoing maxillary surgery. Int J Adult Orthodon Orthognath Surg 4(3):157–174
5. O'Ryan F, Schendel S (1989) Nasal anatomy and maxillary surgery. II. Unfavorable nasolabial esthetics following the Le Fort I osteotomy. Int J Adult Orthodon Orthognath Surg 4(2):75–84
6. Posnick JC, Choi E, Chavda A (2016) Operative time, airway management, need for blood transfusions, and in-hospital stay for bimaxillary, intranasal, and osseous genioplasty surgery: current clinical practices. J Oral Maxillofac Surg 74(3):590–600
7. Posnick JF, Choi E, Adachie A, Trost T (2016) Correction of sintomatic chronic nasal airway obstruction in conjunction with bimaxillary orthognathic surgery: Does it complicate recovery and is it effective? J Oral Maxillofac Surg 74(3):620.e1–629.e11
8. Posnick JC, Fantuzzo JJ, Troost T (2007) Simultaneous intranasal procedures to improve chronic obstructive nasal breathing in patients undergoing maxillary (le fort I) osteotomy. J Oral Maxillofac Surg 65(11):2273–2281
9. Posnick JC, Agnihotri N (2011) Managing chronic nasal airway obstruction at the time of orthognathic surgery: a twofer. J Oral Maxillofac Surg 69(3):695–701
10. Waite PM, Matukas VJ, Sarver DM (1997) Simultaneous rhinoplasty and orthognathic surgery. Int J Oral Maxillofac Surg 17:298–302
11. Ronchi P, Chiapasco M (1998) Simultaneous rhinoplasty and maxillomandibular osteotomies: indications and contraindications. Int J Adult Orthodon Orthognath Surg 13:153–161
12. Seah TE, Bellis H, Ilankovan V (2012) Orthognathic patients with nasal deformities: case for simultaneous orthognathic surgery and rhinoplasty. Br J Oral Maxillofac Surg 50(1):55–59
13. Rosenberg A, Muradin MS, van der Bilt A (2002) Nasolabial esthetics after Le Fort I osteotomy and V-Y closure: a statistical evaluation. Int J Adult Orthodon Orthognath Surg 17(1):29–39
14. Altman JI, Oeltjen JC (2007) Nasal deformities associated with orthognathic surgery: analysis, prevention, and correction. J Craniofac Surg 18(4):734–739
15. Peled M, Ardekian L, Krausz AA, Aizenbud D (2004) Comparing the effects of V-Y advancement versus simple closure on upper lip aesthetics after Le Fort I advancement. J Oral Maxillofac Surg 62(3):315–319
16. Loh FC (1993) A new technique of alar base cinching following maxillary osteotomy. Int J Adult Orthodon Orthognath Surg 8(1):33–36
17. Rohrich RJ, Hoxworth RE, Thornton JF, Pessa JE (2008) The pyriform ligament. Plast Reconstr Surg 121(1):277–281
18. Cottrell DA, Wolford LM (1993) Factors influencing combined orthognathic and rhinoplastic surgery. Int J Adult Orthodon Orthognath Surg 8:265–276
19. Mitchell C, Oeltjen J, Panthaki Z, Thaller SR (2007) Nasolabial aesthetics. J Craniofac Surg 18:756–765
20. Sarver DM, Rousso DR (2004) Plastic surgery combined with orthodontic and orthognathic procedures. Am J Orthod Dentofac Orthop 126:305–307
21. Kawamoto H (1989) Simplification of the Le Fort I osteotomy. Clin Plast Surg 16(4):777–784
22. Mommaerts MY, Abeloos JV, De Clercq CA, Neyt LF (1997) The effect of subspinal Le Fort I—type osteotomy on interalar rim width. Int J Adult Orthod Orthognath Surg 12(29):95–100
23. Hernández-Alfaro F, Guijarro-Martínez R (2013) "Twist technique" for pterygomaxillary dysjunction in minimally invasive Le Fort I osteotomy. J Oral Maxillofac Surg 71(2):389–392
24. Wong DL, Baker CM (2001) Smiling faces as anchor for pain intensity scales. Pain 89:295–300
25. Jensen MP, Karoly P, Braver S (1986) The measurement of clinical pain intensity: a comparison of six methods. Pain 27:117–126
26. Funk W, Podmelle F, Guiol C, Metelmann HR (2012) Aesthetic satisfaction scoring introducing an aesthetic numeric analogue scale (ANA-scale). J Craniomaxillofac Surg 40:439–442
27. Constantian MB (2002) Differing characteristics in 100 consecutive secondary rhinoplasty patients following closed versus open surgical approaches. Plast Reconstr Surg 109(6):2097–2111
28. Daniel RK (2009) Middle Eastern rhinoplasty in the United States: part II. Secondary rhinoplasty. Plast Reconstr Surg 124(5):1640–1648
29. Nassab R, Matti B (2015) Presenting concerns and surgical management of secondary rhinoplasty. Aesthet Surg J 35(2):137–144
30. Guyuron B, Bokhari F (1996) Patient satisfaction following rhinoplasty. Aesthetic Plast Surg 20(2):153–157
31. Hellings PW, Nolst Trenité GJ (2007) Long-term patient satisfaction after revision rhinoplasty. Laryngoscope 117(6):985–989
32. Yu K, Kim A, Pearlman SJ (2010) Functional and aesthetic concerns of patients seeking revision rhinoplasty. Arch Facial Plast Surg 12:291–297
33. Foda HM (2005) Rhinoplasty for the multiply revised nose. Am J Otolaryngol 26:28–34
34. Bracaglia R, Fortunato R, Gentileschi S (2005) Secondary rhinoplasty. Aesthetic Plast Surg 29(4):230–239
35. Lee M, Zwiebel S, Guyuron B (2013) Frequency of the preoperative flaws and commonly required maneuvers to correct them: a guide to reducing the revision rhinoplasty rate. Plast Reconstr Surg 132(4):769–776
36. Berlin NL, Tuggle CT, Steinbacher DM (2016) Improved short-term outcomes following orthognathic surgery are associated with high-volume centers. Plast Reconstr Surg 138(2):273e–281e
37. Sun AH, Steinbacher DM (2018) Orthognathic surgery and rhinoplasty: simultaneous or staged? Plast Reconstr Surg 141(2):322–329
38. Thomson C, Mendelsohn M (2007) Reducing the incidence of revision rhinoplasty. J Otolaryngol 36:130–134