The role of combined rhinoplasty and genioplasty in the improvement of the lateral facial profile

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Background
Genioplasty and rhinoplasty are complementary procedures, which share in common a similar approach for assessment, diagnosis, and stepwise, targeted treatment, based on the existing deformity and cosmetic goals. Previous studies have shown that Egyptians have a tendency toward the skeletal class II with more retrognathic mandibles and more convex profiles in females, and compared with other races, Egyptians tend to have higher facial convexity than other races. Therefore, we chose to stress on the facial harmony in our rhinoplasty patients.
Aim
The aim was to determine for each patient included in the study the best surgical plan to achieve an aesthetically appealing facial profile with a harmonious nose and chin relationship in a population seeking rhinoplasty. The surgical plan is determined with facial analysis, and a suggested treatment plan for best nasal and chin contouring with its options is discussed with the patient to draw attention to the need for chin remodeling for the patient and observe the magnitude of difference in surgical plan regarding the rhinoplasty. The overall percentage of study sample primarily seeking rhinoplasty in need for chin augmentation and/or contouring is estimated to measure the need for chin contouring procedure as an adjunct to rhinoplasty surgery regarding the aesthetic considerations of the lateral facial profile.
Patients and methods
A prospective study was conducted at Ain Shams University Hospitals from September 2015 to December 2018 that included patients who presented to our clinic seeking rhinoplasty.
Results
There was a statistically significant difference in preoperative Legan angle, Silver method, and chin height for a considerable change in total angle of facial convexity by undergoing genioplasty in addition to rhinoplasty. The clinical significance of genioplasty to change the total angle of facial convexity was positively correlated with the patient satisfaction. Overall, 55% of patients presenting for rhinoplasty needed a genioplasty, comprising 50% of included males and 56% of included females. Among the rhinoplasty procedures done, cephalic trimming, cartilage onlay grafts, and columellar strut use showed a clinical significance to the change in nasal projection. Overall, the extent of genioplasty showed a significance to the change induced by our intervention to total angle of facial convexity, unlike the change in nasal projection, where there was no statistical significance in relation to the change of facial convexity.
Conclusion
The chin plays an important role in overall facial appearance, and aesthetic surgery of the chin is extremely rewarding when performed in carefully selected patients. Chin augmentation may improve facial balance and proportion and may also require less reduction of the nose.

Keywords:
combined rhinoplasty, genioplasty, lateral facial profile

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Introduction

Aesthetic genioplasty surgery and rhinoplasty are complementary procedures, which share in common a similar approach for assessment, diagnosis, and stepwise, targeted treatment, based on the existing deformity and cosmetic goals. Orthognathic surgery was developed with the emphasis on addressing malocclusion and jaw discrepancies, but it was quickly realized that these techniques are powerful tools to dramatically enhance facial appearance [1].

Similarly, rhinoplasty has important functional and reconstructive aspects but can very positively affect facial cosmetics. For the best and most aesthetic results, orthognathic (and adjunctive) procedures must be properly planned and executed. Establishing a proper occlusion is only the first level in correction and is necessary but not sufficient alone in achieving the desired facial appearance [2].

Function and aesthetics are both optimally improved, using chin remodeling surgery and rhinoplasty, when performed correctly. This begins with sophisticated recognition and understanding of the imbalances, lack official support, and aesthetic compromise that exists at the initial presentation [3].

A comprehensive understanding of what is normal, what is optimal, and what is cosmetic and aesthetic is of utmost importance. Once the dysmorphology and imbalances are appreciated, a targeted treatment approach is developed to address the concerns and to improve facial and nasal appearance [4].

An engineering mentality and technical acumen are vital, but the subjective 'difference-maker' is the keen artistic eye, appreciation for, and ability to create balance and beauty. This more qualitative and stylistic component cannot be taught but is rather innate. Appreciation of subtleties, and the ability to modify requisite facial tissues, with anticipation and prediction of biological healing, is critical [5].

Both genioplasty and rhinoplasty are technically challenging and often considered among the most difficult operations in maxillofacial and plastic surgery [2].

Objectives

The aim was to determine for each patient included in the study the best surgical plan to achieve an aesthetically appealing facial profile with a harmonious nose and chin relationship in the population seeking rhinoplasty. The surgical plan is determined with facial analysis, and a suggested treatment plan for best nasal and chin contouring with its options is discussed with the patient to draw attention to the need for chin remodeling for the patient and observe the magnitude of difference in surgical plan regarding the rhinoplasty. The overall percentage of the study sample primarily seeking rhinoplasty in need for chin augmentation and/or contouring is estimated to measure the need for chin contouring procedure as an adjunct to rhinoplasty surgery regarding the aesthetic considerations of the lateral facial profile.

Patients and methods

A prospective study was performed at Ain Shams University Hospitals from September 2015 to December 2018 that included patients presented to our clinic seeking rhinoplasty.

Inclusion criteria

Age above 18 years, normal class 1 occlusion (Angel's classification), and overprojected nasal tip and/or nasal hump and/or small, recessed, short chin were the inclusion criteria.

Exclusion criteria

Previous dental trauma, congenital facial defects or syndromes, previous rhinoplasty or orthognathic surgery, bifid or asymmetrical chin, Malocclusion class II or III, concave lateral facial profile, long face deformity, and macrogenia were the exclusion criteria.

Sampling method

A simple random selection method was used for sampling.

Sample size

The sample size calculation was done for patients using PASS 11 to achieve 80% power to detect a difference in the satisfaction score between two study groups with a confidence interval of 95% with an accepted error of 5% at a 0.05 significant level.

Ethical considerations

All patients provided an oral and written consent for the needed procedure, and the study was approved by the ethical committee of our hospital.

Study tools

A Rhinobase software program was used for tracing of facial profile landmarks, angles, and lines to assess the need for relative genioplasty and calculate the angles preopertively and postoperatively. Lateral cephalometry was done to determine the extent of bony work in millimeters.

Statistical analysis

Analysis of data was done by the SPSS (Chicago, USA) program, version 24 using appropriate statistical tests.

Study procedures

The most important aspect of preoperative diagnosis is the clinical examination from the anterior, lateral, and three-quarter views. This allows assessment of the soft tissue facial heights; the anterior, sagittal, and vertical

relationships between the nose and chin to establish facial harmony and balance; and provide an efficient and effective treatment. Preoperative evaluation was performed by the same surgeon who determines a treatment plan, starting with a senior maxillofacial surgeon to exclude any maxillary or mandibular dysmorphism.

The assessment includes radiological evaluation in the form of lateral cephalometry to exclude malocclusion and to estimate the advancement needed for genioplasty in millimeters taking into account the soft tissue shadow. Moreover, chin skeletal analysis incuded the following criteria: the SNA 82(±2) supposed to be normal in our patients, SNB 80(±2) expected to be less than low normal value, and ANB 2(±2) angles to assess whether the patient is in need for soft issue or skeletal genioplasty workout.

Last step of preoperative evaluation was the photography. Photographs were taken from frontal, lateral, three-quarter, and basal angles.

Photographs were obtained according to techniques of standardized 2D clinical photography. We used a commercially available computer program Rhinobase for photograph measurements. Measurements were performed by two different experienced examiners, and the mean was calculated.

The objectively marked landmarks are the landmarks used in this investigation: glabella (G), nasion (N), nasal dorsum (Nd), pronasale (Prn), columella (Cm), subnasale (Sn), labiale superior (Ls), labiale inferior (Li), supramentale (Sm), and pogonion (Pg).

Angular measurements: angular parameters of total facial angle or facial convexity including the nose (N–Prn–Pg) were males = 130.5 ± 3.7° and females = 130.2 ± 3.5°, and facial convexity excluding the nose was males: 168.8 ± 4.96° and females: 169.07 ± 4.72°. This is to diagnose the relatively convex face in patients with normal occlusion. The patient will have more acute angles outside the normal range regarding facial convexity.

Further evaluation for the nose involved the tip. The tip projection was assessed through calculating the ratio between the length of the nose (as determined by a line from the root to the tip) and its height (as determined by a line from the ala to the tip) (Goode, 1984). To calculate the NTP using the Goode's method, three points (Root, Ala, and Tip) are defined on the patient's photograph. Calculation of the nasal tip projection was as follows: nasal height divided by the nasal length and is documented as a percentage. Normal value is as follows: 67 (±5).

Further chin analysis regarding the projection owing to its relative effect on the facial profile was done by two methods for profile analysis: first, the Silver method, where a perpendicular line is dropped from the Frankfort horizontal line tangent to the lower lip vermilion cutaneous border. The pogonion (the anterior most projection of the chin) should be at or up to 2 mm behind this line. Legan and Burnstone (1980) used the concept of facial convexity angle to assess the relationship between the chin and the nasal projection according to their analysis. The 'ideal' angle of facial convexity should be between 8 and 16°. Patients having retruded chin according to Silver method more than 2 mm and/or a Legan angle more than 16° were indicated for chin contour remodeling in the horizontal plane.

The chin height was assessed according to the rule of being one-third of the lower facial height. Surgery was considered if chin height was greater than 50% and less than 20–23% of lower facial height in males, and greater than 58% and less than 20–22% of lower facial height in females.

Angular and linear assessments were done by drawing the lines described over the patients' photographs using the Rhinobase program and measuring the required angles and documenting facial soft tissue analysis parameters preoperatively.

Each patient was assessed regarding the need for rhinoplasty and/or genioplasty. As for rhinoplasty for nasal tip overprojection correction, which was performed for all of the patients, the second type of procedure was genioplasty after facial profile assessment. Genioplasty is a sliding technique to be stabilized by titanium plates and screws.

Postoperative assessment was done 6 weeks, 3 and 6 months, clinical evaluation, together with patient's satisfaction by 'Aesthetic Numerical Analogue' 10 point scaling will be documented preoperative and postoperative. Items for studying patient satisfaction were derived from the FACE-Q questionnaire, the aesthetic version. Lateral cephalograms were taken in the centeric position. Photographs were repeated the same way as was done preoperatively; same measurements were compared to document the difference imposed by surgical intervention to be correlated to postoperative patient satisfaction. The percentage of the patients in need for genioplasty procedures among the rhinoplasty

patient sample was estimated for males and females separately.

Surgical details for genioplasty (Fig. 1)

The patient was placed supine on the operating table with the head positioned in a semiextended position on the head rest. The entire face, forehead, periorbita, ears, mouth, and neck were prepped with betadine or chlorhexidine solution, paying careful attention to protect the corneas. Steri-strips were placed to secure the eyelids. A head drape is placed securing the patient's hair and clearing the operative field. It is imperative to visualize the entire face given the chin's role in facial harmony. A throat pack is placed into the oral pharynx to minimize ingestion of irrigation solution and blood throughout the procedure. Local anesthetic is injected for regional anesthetic and hemostatic effect before incision. Typically, dexamethasone is administered preoperatively to control postoperative edema when genioplasty is performed in concert with orthognathic surgery. Perioperative antibiotics are administered to minimize the risk of surgical site infections (i.e. cefazolin or clindamycin).

The osseous genioplasty is performed using an intraoral, gingivobuccal sulcus approach. In cases demanding an alloplastic implant, the device may be placed either intraorally, or via a small submental incision.

The anterior labial vestibule is incised using a 15-blade scalpel perpendicular to the mucosa with a dart designed at the lower lip frenulum. The incision is drawn at least 10 mm from the mucogingival line to preserve mobile tissue and permit tension-free closure.

Using needlepoint electrocautery, a horizontal incision is carried through the mentalis muscle preserving a superior muscle cuff for precise mentalis reattachment at closure. Blunt dissection is then performed with a periosteal elevator to expose the bony chin and inferior border and to visualize and free the mental nerves. Careful attention is made to avoid avulsion or injury to the nerves at the mental foramina.

The osteotomy is then planned. First, the midline is marked above and below the location of the horizontal cut. The osteotomy is scribed with a sterile pencil or marker above the pogonion, avoiding the mental nerves but typically extending angulation and wedge resection might be planned based on anticipated goals of correction. The planned osteotomy(ies) are performed using a reciprocating saw. Copious irrigation is used to prevent thermal injury to the mandible and surrounding structures. The genioglossus muscle is left attached to the genioplasty segment to retain blood supply.

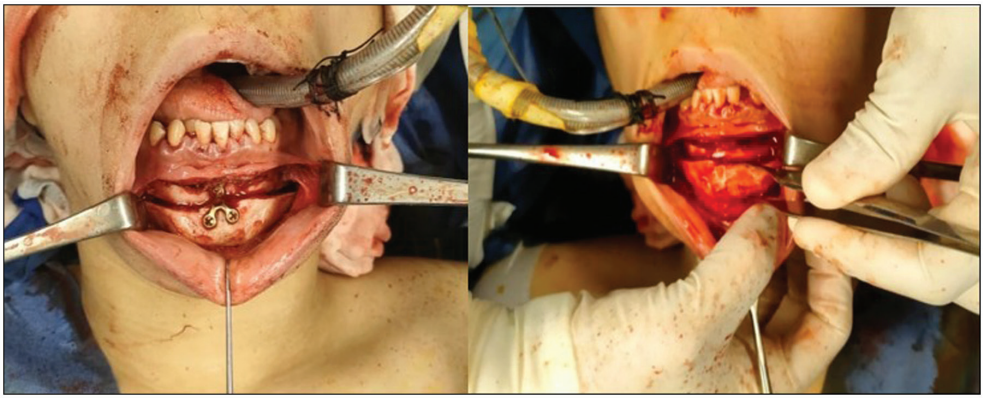
The mobile genioplasty segment is repositioned as desired in space and secured to the mandible using titanium plates and screws to achieve the goals of the procedure. Fixation options include the X-plate, which we used in our technique.

Redraping of the lower lip and chin tissue is essential during genioplasty to ensure that the planned and achieved position matches the desired aesthetic goals.

Precise reattachment of the mentalis muscle over the plate/screws is critical. This ensures adequate hardware coverage as well as good functional (lower lip/mentalis function) and aesthetic (soft tissue volume/contour and avoid witch's chin) outcomes.

Multiple interrupted 2-0 vicryl sutures were used to reapproximate the muscle and median raphe. The overlying mucosa was then reapproximated with 4-0 chromic gut sutures.

Figure 1



Intraoperative photographs after osteotomy and plate fixation.

A chin dressing was applied using Elastoplast (surgical tape) to provide additional support, aid mentalis reattachment, and limit edema to the chin postoperatively.

Results

It was evident from our study there is a statistically significant difference in preoperative Legan angle, Silver method, and chin height for a considerable change in total angle of facial convexity by undergoing genioplasty in addition to rhinoplasty. The statistical significance of genioplasty to change the total angle of facial convexity was positively correlated to the patient satisfaction. Overall, 55% of patients presenting for rhinoplasty needed a genioplasty, comprising 50% of included males and 56% of included females. Among the rhinoplasty procedures done, the cephalic trimming, cartilage onlay grafts, and columellar strut use showed a clinical significance to the change in nasal projection. Overall, the extent of genioplasty showed a significance to the change induced by our intervention to the total angle of facial convexity unlike the change in nasal projection, there was no statistical significance in relation to the change of facial convexity (Tables 1–9 and Figs 2 and 3).

Table 1 Description of patient demographic data

Demographic data	*N*=20
Age	
Mean±SD	25.15±7.35
Range	18–43
Sex [*n* (%)]	
Female	16 (80.0)

Table 2 Description of preoperative chin measurements, nasal measurements, and facial convexity (mean and range)

Preoperative	*N*=20
Legan	
Mean±SD	18.55±6.09
Range	2–30
Silver [*n* (%)]	
No	10 (50.0)
Yes	10 (50.0)
Chin height	
Mean±SD	29.10±13.28
Range	15–53
Nasal projection	
Mean±SD	0.62±0.07
Range	0.5–0.75
Nasolabial angle	
Mean±SD	95.10±3.95
Range	90–102
Total angle of facial convexity	
Mean±SD	128.40±5.92
Range	121–145
Angle of facial convexity	
Mean±SD	189.65±8.83
Range	172.3–204

Discussion

A flawless face is a myth as it depends on personal taste and is closely correlated with cultural and racial stereotypes. However, our fascination with defining standards of face aesthetics dates back to ancient civilizations and has been immortalized in art throughout time. The idea of face harmony was developed not least by the brilliant Leonardo da Vinci in the 15th century when scholars found common 'aesthetically pleasing' qualities and started defining criteria. He famously split the ideal face into horizontal thirds and vertical fifths in his sketches. The preoperative evaluation needed by a modern face plastic surgeon has grown increasingly sophisticated in light of the recent boom in attempts to compare facial characteristics with ideal mathematical ratios and geometrics [6].

Aufricht was the first to discuss the nose to chin relationship, saying that '… they are important components of the profile which are markedly interrelated…' and 'the prominence of one will influence the relative prominence of the other.' He was also the first to do a chin augmentation using the dorsal nasal hump [7].

Table 3 Description of operative rhinoplasty procedures and percentage of intervention by each procedure

Rhinoplasty	*n* (%)
Tip [*n* (%)]	
Rib grafting	2 (10.0)
Transdomal sutures	20 (100.0)
Interdomal sutures	20 (100.0)
Cephalic trimming	13 (65.0)
Columellar strut	12 (60.0)
Crushing of tip graft	7 (35.0)
Alar reduction	7 (35.0)
Cartilage graft onlay	10 (50.0)
Dorsum [*n* (%)]	
Osteotomy	20 (100.0)
Rib grafting	1 (5.0)
Soft tissue augmentation	9 (45.0)
Rasping	20 (100.0)
Genioplasty	11 (55.0)

Table 4 Percentage of rhinoplasty patients undergoing genioplasty out of total number of patients

Sex	Genioplasty
	N=11 [*n* (%)]
Female	9 (81.8)
Male	2 (18.2)

Table 5 Percentage of Rhinoplasty patients undergoing genioplasty out of number of same sex patients

	Female	Male
	N= 16	*N*=4
Genioplasty [*n* (%)]	9 (56.2)	2 (50.0)

Table 6 Difference induced by intervention in preoperative chin measurements, nasal measurements, and facial convexity angles and its statistical significance

	Preoperative	Postoperative	Difference	Test value	*P* value	Significance
	N=20	*N*=20	Mean±SE			
Legan						
Mean±SD	18.55±6.09	15.60±2.58	–2.95±1.10	–2.678•	0.015	S
Range	2–30	8–20				
Silver						
No	10 (50.0%)	20 (100.0%)	–	13.333*	0.000	HS
Yes	10 (50.0%)	0				
Chin height						
Mean±SD	29.10±13.28	34.35±8.30	5.25±1.26	4.172•	0.001	HS
Range	15–53	25–53				
Nasal projection						
Mean±SD	0.62±0.07	0.65±0.02	0.03±0.01	2.018•	0.058	NS
Range	0.5–0.75	0.6–0.68				
Nasolabial angle						
Mean±SD	95.10±3.95	101.35±4.45	6.25±0.79	–7.935•	0.000	HS
Range	90–102	91–108				
Total angle of facial convexity						
Mean±SD	128.40±5.92	132.90±3.55	4.50±1.06	4.255•	0.000	HS
Range	121–145	128–145				
Angle of facial convexity						
Mean±SD	189.65±8.83	183.69±7.75	–5.96±2.38	–2.502•	0.022	S
Range	172.3–204	160–193.3				

*χ^2 test. •Paired *t* test. ‡Wilcoxon signed-rank test. *P* value greater than 0.05, nonsignificant (NS). *P* value less than 0.05, significant (S). *P* value less than 0.01, highly significant (HS).

The face may be split into thirds randomly by placing imaginary lines at the glabella and the subnasale. The face extends from the trichion (hairline) to the menton (lowest point of the chin). In frontal and profile perspectives, the 'balance' should be 'harmonious.' The chin comes in second place, at least from a profile standpoint, but the nose has received the most attention as it is the most prevalent location of irregularity and technically the most challenging to fix. Facial cosmetic surgeons have known this for a long time, but patients who come in for a nose job frequently need to be reminded of it [8].

The labiomental sulcus to the menton comprise the actual chin. It is made up of soft tissues, the anterior most portion of the mandible, and the chin pad, which is made up of the mentalis and labial depressor muscles (the mental protuberance and tubercles).

An aesthetic sensibility that experienced facial plastic surgeons have developed may frequently be sufficient to determine a balanced final postoperative appearance. Nevertheless, this should be reinforced by conventional, ideally measurable techniques of assessment, especially for relatively new surgeons. As the majority of the chin variation can be seen in the profile view, this view was chosen for our investigation. The evaluation must be straightforward to complete, repeatable, and correspond to the accepted aesthetic facial lines as with any other region of the face. As we have seen, several writers have discussed numerous techniques for evaluating the chin in the profile view, which is an evidence that none of them seem to be perfect. Depending on the technique of the study, the incidence of horizontal microgenia in earlier research varied substantially. To validate surgical intervention, we recommend employing many methods. In our study, we used the silver method and Legan angle to assess chin projection. Both showed clinical significance in relationship with intervention in rhinoplasty patients by genioplasty. The extent of the surgery may be determined by one of the assessment techniques used, but the surgeon's aesthetic sense and the patient's personal preferences will also play a significant role. Therefore, we supplemented the surgeon clinical sense with quantitative data by obtaining the preoperative cephalometric analysis and soft tissue measurement to justify the patient complaint besides the surgeon experience and preference for each case. The aim of this paper was to highlight quantitatively the relatively high prevalence of microgenia in a population of patients presenting for rhinoplasty. In reality, the aforementioned analysis simply indicates the 'possible' need for adjunctive mentoplasty. The total workup is necessarily more complex. We started by preoperative orthodontic assessment by a maxillofacial surgeon to exclude the need for orthodontic treatment before we proceed to chin remodeling to exclude a primary

Table 7 Description of patient satisfaction regarding appearance, health-related quality of life, and adverse effects, derived from FACE-Q

Patient satisfaction	*N*=20
Appearance	
Nose	
Median (IQR)	10 (9–10)
Range	8–10
Chin	
Median (IQR)	10 (9–10)
Range	8–10
Area under chin	
Median (IQR)	10 (9–10)
Range	9–10
Health-related quality of life	
Appearance distress	
Median (IQR)	0 (0–1.5)
Range	0–10
Expectations	
Median (IQR)	7 (6–8)
Range	5–10
Outcome	
Median (IQR)	9 (9–10)
Range	8–10
Psychological	
Median (IQR)	9 (9–10)
Range	8–10
Recovery early symptoms	
Median (IQR)	7 (6–8)
Range	4–10
Adverse effects [*n* (%)]	
Chin	
No	20 (100.0)
Nose	
No	20 (100.0)

mandibular dysmorphism, such as a micrognathia (hypoplasia of the mandible) or retrognathia (retrusion of the mandible in comparison with the maxilla) with dental occlusal defects. We had five patients who were initially enrolled in the orthodontic treatment before correction of lower facial one-third deficiency, and hence, they were excluded from our sample. Our prospective timeline, which entails, facial analysis and cephalometric assessment and then surgical intervention and result analysis, clinically investigated the previous literature suggestion regarding the need for mentoplasty in the rhinoplasty population. In fact, the study overcame the pitfall of theoretical suggestion and turned it into quantitative results. It was suggested by Jahanjir *et al*. (2010) in a retrospective study that patients presenting for rhinoplasty would probably benefit from mentoplasty suggestion by the surgeon if the patient is not aware of dysmorphology in facial lower one-third, which is a common problem. Their retrospective analysis suggested that 17 to 62% of males presenting for rhinoplasty would have probably benefited from the combined procedure according to the preoperative facial assessment by four methods to assess chin measurements in the horizontal plane (the four methods are Sliver, Merrifield angle, Gonzalez, and Legan angle), whereas 42% to 81% of female population would benefit from the combined procedure. Our results confirmed previous suggestions, as the difference in total facial convexity angle which includes the nasal tip showed a clinical significance to the improvement of patient satisfaction [6].

We chose the Legan angle for discrete assessment of chin relationship to maxilla, and the Silver method for assessment of nasal tip relation to chin projection, and chin height, all in profile view which is the view we are mainly concerned with in our study. Additional outcomes we got from using these methods were for example excluding maxillary hypoplasia and second the cephalometric analysis. Maxillary hypoplasia may significantly bias the result of many of the assessment methods, although Legan's analysis of ideal facial convexity may highlight this defect if not immediately apparent. The vertical height of the chin will to some extent dictate the method of chin augmentation.

The ratio of the upper lip (subnasale to stomion) and the chin and lower lip combined (stomion to menton) should be 1:2.9. Profile analysis of lower lip protrusion and thus depth of the labiomental sulcus is also important. In general, augmentation of the chin in the absence of mandibular dysmorphism is performed by means of either an alloplastic implant or by a genioplasty procedure [6]. The former augments only in the horizontal plane however. It will thus lead to a prominent 'pointy' chin with an excessively deep neolabiomental sulcus if used in a patient with vertical microgenia or an excessively protuberant lower lip.

In both of these situations, the more flexible, but technically more demanding, genioplasty may be more appropriate. There was clinical significance in operative change in Silver method and chin height and Legan angle for the decision to undergo genioplasty in addition to rhinoplasty, which in turn dictates assessment tools of help to the surgeon to confirm the patient's need for chin remodeling. The clinical significance of genioplasty to change the total angle of facial convexity was positively correlated to the patient satisfaction. Moreover, the extent of chin advancement showed a clinical significance to change in total angle of facial convexity, and this reflects in the improvement of the lateral facial profile. On the contrary, the nasal projection did not show a statistical significance to change in lateral facial convexity.

Table 8 Relationship between difference induced by surgical intervention and different rhinoplasty procedures, it shows that cephalic trimming, use of columellar strut, and onlay cartilage graft are statistically significant to change in nasal projection

	Nasal projection difference		Test value‡	*P* value	Sig.
	Mean±SD	Range			
Rib grafting					
No	0.04±0.04	0–0.15	−1.576	0.115	NS
Yes	0.00±0.00	0–0			
Cephalic trimming					
No	0.07±0.06	0.00–0.15	−2.282	0.023	S
Yes	0.00±0.05	−0.10–0.05			
Columellar strut					
No	−0.02±0.05	−0.10–0.05	−2.650	0.008	HS
Yes	0.06±0.05	−0.03–0.15			
Crushing of tip graft					
No	0.05±0.05	0–0.15	−0.743	0.457	NS
Yes	0.02±0.03	0–0.05			
Alar reduction					
No	0.04±0.05	0–0.15	−0.372	0.710	NS
Yes	0.03±0.04	0–0.11			
Cartilage graft onlay					
No	−0.01±0.05	−0.10–0.05	−2.597	0.009	HS
Yes	0.06±0.05	0.00–0.15			
Rib grafting					
No	0.04±0.04	0–0.15	−1.085	0.278	NS
Yes	0.00±0.00	0			
Soft tissue augmentation					
No	0.05±0.05	0–0.15	−0.079	0.937	NS
Yes	0.03±0.03	0–0.08			
Genioplasty					
No	0.06±0.05	0–0.15	−1.861	0.063	NS
Yes	0.02±0.02	0–0.05			

‡Mann–Whitney *U* test. *P* value greater than 0.05, nonsignificant (NS). *P* value less than 0.05, significant (S). *P* value less than 0.01, highly significant (HS).

Table 9 Effect of change in nasal projection and extent of chin advancement in change of angle of facial convexity

	Difference of total angle of facial convexity	
	R	*P* value
Difference of nasal projection	−0.307	0.187
Extent of chin advancement (mm)	0.807**	0.000

**Highly significant.

This was a good point in our study. The results are linked to patient satisfaction which can help in dictating better management routes in future cases, not only dependent on numerical measurements without going through patient counselling and feedback.

The prevalence of microgenia in the 'normal population' is not known. It will inevitably vary between different ethnic groups. Our local population was all Egyptian patients; consequently, our population is white. Previous studies showed that Egyptians have a tendency toward the skeletal class II with more retrognathic mandibles and more convex profiles in females, and compared to other races, Egyptians tend to have higher facial convexity than other races. Therefore, we chose to stress on the facial harmony in our rhinoplasty patients [9,10].

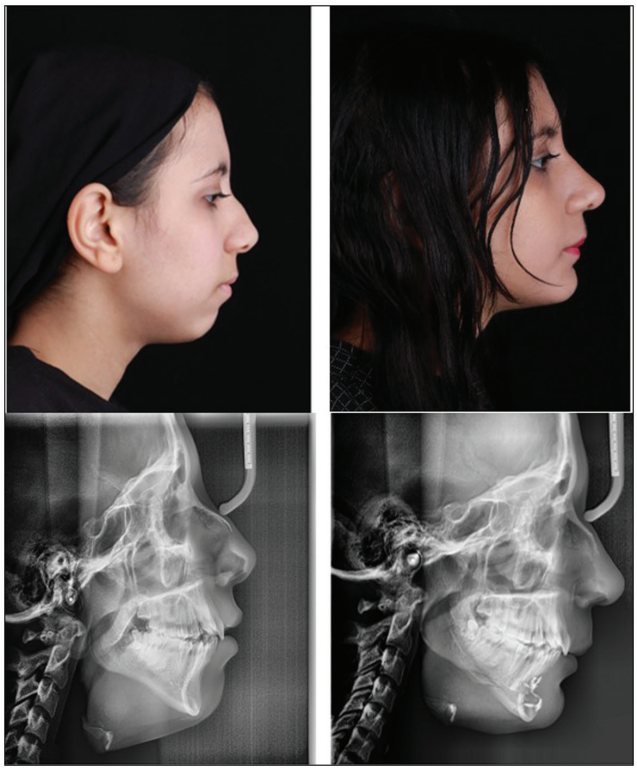
Jahanjir and colleagues investigated retrospectively the need for genioplasty as an adjunct to rhinoplasty on ethnically diverse population, where 50% (20 of 40) of our female patients and 52% (31 of 60) of males were of Indian origin. The majority of the remainder (43 and 48% of females and males, respectively) were white. This distribution may have biased their results. In the rhinoplasty population, the prevalence of microgenia has been anecdotally described as between 15 and 20%.

However, our results show that it can be higher in Egyptians. Moreover, further studies quantifying the figure in a larger Egyptian population and even categorizing the types of microgenia and the prevalence of each may be more helpful. It is important to mention that our small sample size is a limitation of our results and needs confirmation by more studies to generalize the outcome. Furthermore, the percentage varies depending on the method of assessment. A more realistic assessment should use multiple, stylistically different methods. We chose Silver's with Legan's

Figure 2

Patient 1 (Rhinoplasty only): lateral preoperative and postoperative photographs and lateral cephalometrical analysis.

Figure 3



Patient 2 (Rhinoplasty and genioplasty): lateral preoperative and postoperative photographs and cephalometrical analysis.

analysis. The need for genioplasty was very high when using the method outlined by Silver method. Therefore, we did not depend on the Silver's method alone for preoperative assessment for genioplasty. If the patient is positive for both methods, we can proceed to genioplasty; however, statistically, Legan angle assessment was significant.

One should bear in mind that the patient who has presented for correction of the nose is often not aware of the contribution to the facial profile of their microgenic or retruded chin. We recommend that time should therefore be spent in conjunction with preoperative images to explain the possible effect of chin correction on their postoperative appearance. As our results show statistical significance of the extent of genioplasty to correction of total angle of facial convexity, unlike the nasal projection, which did not show a statistical significance. This dictates our recommendation to consider strongly genioplasty and expand patient counselling about the procedure when meeting a likely convex or concave lateral facial profile patient coming for rhinoplasty. We feel that it is important to go through these steps even if local policy does not allow for such cosmetic surgery. It may alleviate potential postrhinoplasty disappointment. We found a positive correlation between the changes in total angle of facial convexity and patient postoperative satisfaction.

Today genioplasty is an easy surgical procedure that can be done by osteotomy or by positioning alloplastic materials, but some controversies have yet to be addressed. When performing a genioplasty, we prefer an intraoral approach with an incision line running between the two canines. Zide and Ellis (1995) have commented on the importance of the mentalis muscle in chin surgery. Chaushu *et al*. [11] have shown that when the mentalis muscle insertion is not precisely repositioned, this leads to chin and submental-cervical soft tissue ptosis.

For this reason, we avoid a wide muscular detachment (not 5 mm below the teeth apex) and tape the chin with three adhesive elastic bands for 2 days followed by an elastic dressing during the night for 15 days. Regarding the choice between advancement osteotomy and an autologous or heterologous graft, some surgeons are concerned that allografts can rarely become infected or cause bone resorption in the recipient site, may be incorrectly placed, or may undergo subsequent displacement. No infection, bone resorption, or fixation instability was found in our patients, as reported in some series.

All of our patients were treated with an open rhinoplasty. None of them showed major complications, such as hematoma, severe residual asymmetries, or functional impairments. The esthetic result was evaluated after

12 months and was deemed successful. The findings of this study agree with the work of Guyuron and Raszewski (1990), who state that a chin osteotomy is a safe procedure that is well established and can be applied individually or in combination with a rhinoplasty, achieving good results and avoiding the added costs of an alloplastic material. This conclusion benefits both the patient and the surgeon.

To obtain a good result, one must observe the following: accurate case selection, which implies recognizing the coexistence of defects in the nose and chin, accurate preoperative evaluation with photographs and radiographs to know what correction are needed and to identify structures that are to be preserved, and correct surgical procedure (chin muscle, inferior alveolar nerve preservation, and accurate bone fixation with titanium mini-plates).

Another aspect to consider is the surgical effect on the patient. By using a simultaneous nose–chin correction procedure, the patient does not require a second surgical session, thus reducing postoperative discomfort and reducing the overall cost.

Moreover, when an osteotomy is used for chin correction, a higher level of predictability and stability is observed, and there are little or no complications except for transitory inferior alveolar nerve hyposensitivity. Furthermore, genioplasty can stretch submandibular soft tissues with better aesthetic outcomes.

This is shown in our results through the excellent patient satisfaction for chin and area under the chin. Previous studies show that the use of alloplastic implants gives much less predictability for a long-term fixed position, can cause bone resorption, and leaves a submental scar when placed from an extraoral approach. Considering these results, single-session rhinoplasty and osseous genioplasty should be proposed for the patient every time the aesthetic surgeon sees coexistence of nose and chin deformities.

We chose to do all patients who needed genioplasty the osseous type with good repair for metalis muscle, to avoid the complications of allografts. Osseous genioplasty is a more flexible and versatile procedure that can correct chin deformities in all three planes of space. When properly planned and executed, both procedures provide important adjuncts for the facial plastic surgeon.

We have additional findings regarding rhinoplasty and its contribution to change in total angle of facial convexity and nasal projection, in detailing the rhinoplasty procedures and studying the effect of each procedure statistically on nasal projection. It was found that three steps show statistical significance to the change in nasal projection, which will have an aesthetic contribution in turn to improve the lateral facial profile. The three procedures are the cephalic trimming, use of columellar strut and onlay cartilage graft, which we used intraoperatively to modulate the nasal projection to give a tip definition without increasing the nasal projection out of normal Goode's ratio to maintain a balanced nose–chin relationship. In three patients, we performed a combination of deprojection by overlapping medial crurae and addition of an onlay cartilage graft to achieve a good tip definition without overprojecting the nasal tip. So, we were keen to stick to our rationale in approaching the patient and considering nose–chin relationship, that is, mid and lower two-thirds of the face harmony. We are not only performing rhinoplasty because the patient requests the procedure, we recommend surgeon and patient orientation and counselling for a better satisfaction and quality of life.

Conclusion

The chin plays an important role in overall facial appearance, and aesthetic surgery of the chin is extremely rewarding when performed in carefully selected patients. Chin augmentation may improve facial balance and proportion and may also require less reduction of the nose.

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Conflicts of interest

There are no conflicts of interest.

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