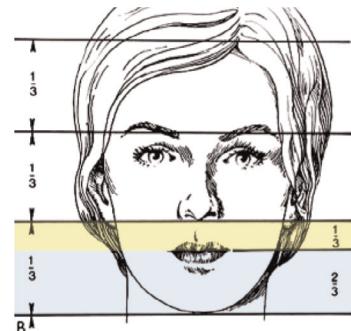


# Orthognathic surgery of adults and facial aesthetics

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## ABSTRACT

*Orthognathic surgery has as its objective the repositioning of basal bone in the framework of maxillo-mandibular deformities. Its results are both esthetic and functional. For adults, improved aesthetics results is becoming increasingly important in these procedures to the point where some patients seek only an esthetic amelioration and not a functional one. To achieve their aesthetic purpose, it is becoming progressively more necessary for orthodontists, oral surgeons, and general dentists to collaborate effectively in a well-coordinated effort. In what has now become a true sub-specialty, orthognathic surgeons must master the complementary techniques of rhinoplasty, osseous apposition, aesthetic facial surgery, fat injection or injectable anti-aging treatments. In this article we propose a diagnostic classification based on the aesthetics of the adult smile and describe the therapeutic modalities appropriate for each element.*

## KEY WORDS

*Orthognathic surgery,  
Aesthetics of the face,  
Orthodontic and orthognathic treatment.*

## 1 – INTRODUCTION

Orthognathic surgery, or surgery of maxillo-mandibular bones, has for its purpose correction of malpositions of basal bone and the malocclusions that is often associated with them.

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The objectives of this multi-disciplinary team care are both functional, re-establishment of static and dynamic occlusal capacities; and morphological, a stable restitution of the skeletal balance of the face, which, as we shall see, most often focuses on esthetic improvement of the visage.

This management of dento-facial skeletal anomalies is accomplished by a multi-disciplinary team based on close collaboration between surgeon and orthodontist who ask other participants to join in their endeavors. Surgeons cannot achieve balanced restructuring of skeletal elements unless preliminary stages of dental treatment have been completed in accordance with a rigorous treatment plan elaborated by surgeons and orthodontists assisted by general practitioners, implantologists, and speech therapists or other teaching specialists.

This type of morpho-functional surgery of the face has developed considerably over the past 15 years, particularly for adults, because of the great improvement in orthodontic techniques, in surgical osteosynthesis materials, and the systemization of surgical techniques and also because of a better integration of the multi-disciplinary protocol, especially with regard to orthodontics and surgery, and amelioration of functional re-education methods. That is why this type of treatment that was only a few years ago daunting to practitioners and prospective patients, is being prac-

ticed routinely in many dentofacial orthopedic offices and clinical centers.

In this article we don't intend to present an exhaustive orthodontic-and orthognathic treatment approach but instead we plan to review the basis for and the philosophy of these procedures that, above all, consist of a joint effort whose success depends upon effective collaboration between members of a multi-disciplinary team. We shall offer an esthetic "extra-oral" clinical approach not focused on occlusal anomalies but on **anomalies of the positions of teeth within the smile** and the therapeutic options that we have at our disposal for **placing those teeth in correct positions within the smile**.

In the first section of this article we shall outline the objectives of the orthodontic-and orthognathic treatment, we shall make clear what kind of an assessment is needed to establish such protocols, and we shall describe different indications for treatment in response to the varying positions of teeth within the smile.

To conclude, we shall discuss the implications of planning highly individualized surgical procedures based on clinical and esthetic analyses of every patient. To support this innovative approach we shall then show the records of clinical cases for which we have not strictly adhered to traditional notions of contact between upper and lower lips at rest and the normalization of the maxillary occlusal plane.

## 2 – GENERAL COMMENTS

The term "orthognathic" comes from the Greek *ortho* (straight) and

*gnathos* (jaw). This straight jaw surgery developed only recently, largely

during the exuberant growth of medical and dental science over the last thirty years, when it emerged from maxillo-facial surgery, to become a sub-specialty of its own, orthognathic surgery was aided by collaboration of dento-facial orthopedic colleagues. This joint effort of surgeons and orthodontists has made it possible for team members to establish corrective treatment plans with precision and to execute them with rigor.

Beauty, which is a central concept in all cultures, and physical appearance have always played key roles in the development of individual self esteem, in the establishment of interpersonal relations, and even the quality of life, are, accordingly carefully considered in these treatment plans. So the competence of orthognathic surgeon in no way limits itself to a mechanical occlusal or stomatological approach but integrates knowledge of the techniques of cosmetic surgery of the visage with procedures for correcting basal bone. The orthognathic surgeon is, above all, a surgeon of the face who is philosophically committed to incorporating surgery of the jaws with plastic surgery and reconstruction of the face.

## 2 – 1 Vertical analysis

From a frontal view, the maxillo-mandibular jaws, composed of the two maxillary bones and the mandible, occupy the middle and lower thirds of the face. Artists consider the face to be divided in three stages of equal height, whose respective cutaneous limits are the anterior zone of the insertion of the hairline, the upper

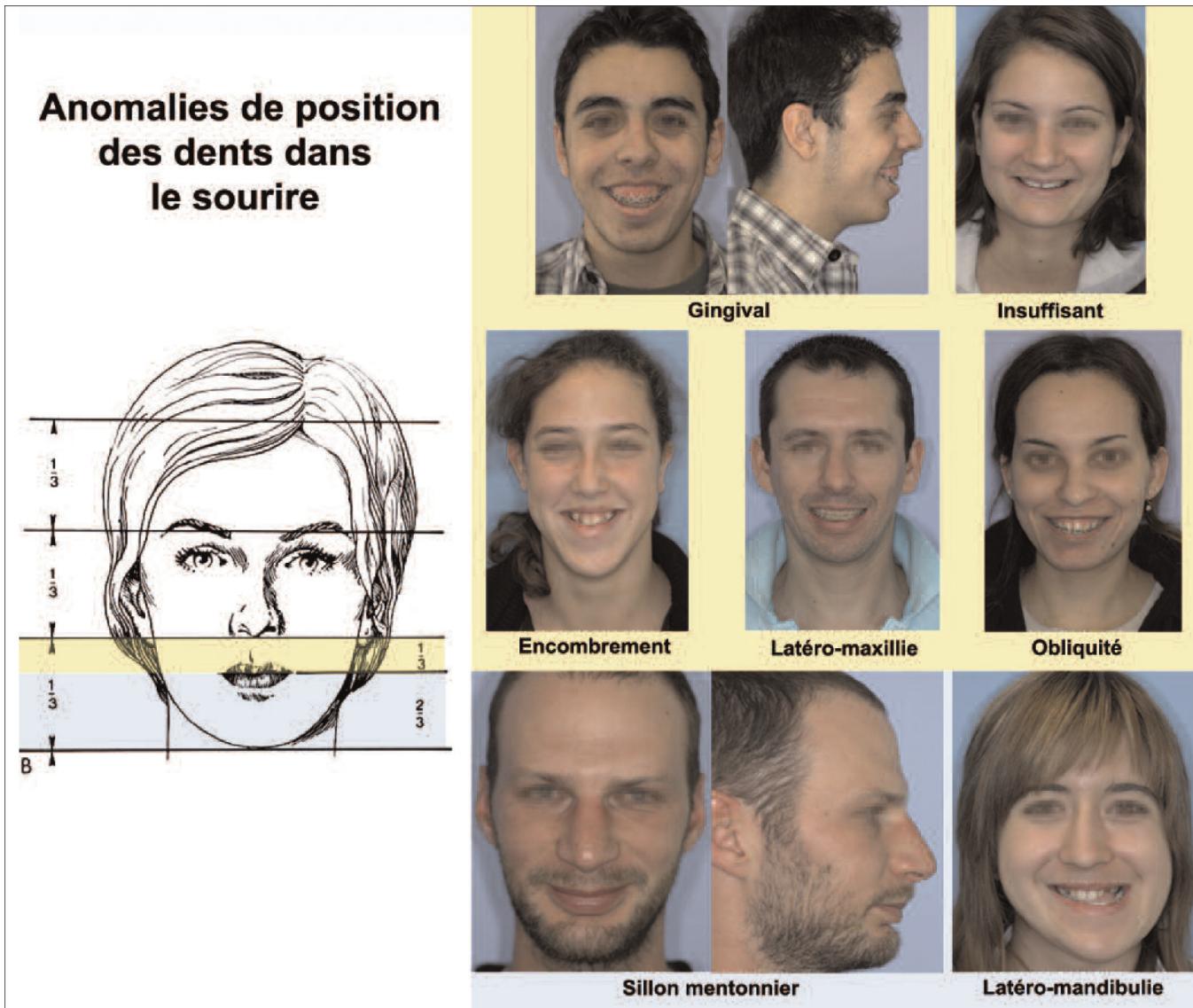
border of the eyebrows, the sub-nasal point, and the sub-mental point. The area of activity of orthognathic surgeons is primarily the lower third of the face, which is itself divided into three stages of equal height:

- the first stage extends from the free edge of the columella to the intercommisural line of the lips;
- the two other stages extend from the intercommisural line to the free edge of the chin (Fig. 1).

## 2 – 2 Sagittal analysis

In the sagittal plane, a lack of balance of the profile is often correlated with a lack of facial balance. The esthetic considerations of the profile of the visage act so that a harmonious visage ought to be presented. Current esthetic standards seek, above all, to present the lower third of the face that is synonymous with youth. Actually, from an esthetic point of view "anything that retreats grows older, everything that advances rejuvenates." Why do older people look old? Because of the atrophy of fatty cheek tissue and drooping of the cheek's cutaneous covering that reduce the projection of the middle stage of the face and because loss of teeth deprives lips of support as bi-maxillary retrusion takes place.

Accordingly, there is often a correlation between the esthetic approach for the visage of the face and the profile because the normo-divergent transfacial profile with contact of the upper and lower lips at rest corresponds most closely to contemporary esthetic norms.



*Figure 1  
Classification of the anomalies of positions of teeth in the smile.*

In addition to establishing a stable functional occlusion, orthognathic surgeons tend to have esthetic objectives that include creating vertical balance between various facial units with a major focus on obtaining lip

contact at rest and assuring the stability of treatment by having labial muscles bundles act as a retaining force, and providing good nasal ventilation when lips are closed at rest. In the absence of bilabial contact, the

law of least effort induces children to choose mouth breathing leaving the tongue free to push against teeth and risk of making them progressively more mobile. Moreover, a spontaneous lips closed posture at rest confers a relaxed and refreshed appearance to the visage and improves the esthetic aspect of the entire face.

A continuous thrusting of the tongue between the incisor teeth can

loosen them perceptibly and some patients keep this up for years. To prevent this from happening, the treatment team must arrange for an anterior deep bite and try to train patients to permanently control their tongues from passing between upper and lower teeth. Otherwise some extent of relapse is inevitable.

### 3 – ANOMALIES OF TOOTH POSITION IN THE SMILE: ASSESSMENT AND TREATMENT PLAN

As a smile unfolds, the lips part and the upper lip reveal the maxillary anterior teeth between the right and left premolars. Normally, the upper incisors are fully visible right up to the gingival festoon line. Uncovering of teeth in faulty smiles can range from showing too much gingiva, a gummy smile, to an insufficient revealing of teeth or to oblique or asymmetric revealing of teeth associated with a tilted occlusal plane.

The orthognathic surgeons' competence in treating is limited to adjusting the position, the dimensions, or the volume of the lips. They can improve smiles by modifying basal bone in either or both jaws. They can reposition teeth in the smile and achieve contact between upper and lower lips at rest to give the visage a harmonious and relaxed appearance.

Surgeons must also set, according to each case, functional and esthetic objectives to correct any antero-posterior or transverse disharmonies as well as asymmetries.

#### 3 – 1 Treatment plan

All team members must participate in the systematic elaboration of treatment plans for patients presenting maxillo-mandibular disharmonies. In routine practice, this assessment will include the following points.

- **General evaluation of the patient**

Patients who are candidates for possible orthodontic-surgical treatment are usually in good health. However, since these procedures are sometimes offered to patients of somewhat advanced years, treatment planners must make a systematic search for any existing diseases, especially cardio-pulmonary diseases, that may be severe especially in prospective patients with ventilation problems like sleep apnea.

The team must make a thorough presentation to patients about the advantages, inconveniences, and risks inherent in these therapies.

Potential hemostasis problems must be carefully evaluated through

questioning patients and using prothrombin testing or the international normalized ratio (INR) because this surgery can potentially cause hemorrhaging.

Then treatment planners should complete their general evaluation of patients by a scrupulous analyses of their dental histories and, only after all this, begin the preliminary orthodontic treatment, during which a further study of the patient's tolerance for treatment, state of oral hygiene, and dental and periodontal health.

Taking into account its affect on microcirculation and the healing process, it is indispensable to inform patients of the harmful effect of consuming tobacco, and that they must cease using it at least one month before treatment begins.

#### • **Socio-physiological evaluation**

It is essential for the team to undertake socio-physiological evaluations of patients before beginning any surgical or orthodontic therapy. The course is going to be long and arduous for the patients, and they must be well motivated from the start. These therapies are markedly different from orthodontic treatment alone.

Patients must understand that once treatment begins it will be difficult to reverse course especially since some skeletal modifications change the visage profoundly.

We believe it is advisable for psychologists to review the overall commitment that is involved particularly because most patients' primary reason for seeking therapy is to obtain esthetic benefits.

They may find it difficult to comprehend the occlusal and morphological

aspects of therapy if they have no background in medicine. Of course, we are prepared and quite willing to show them records of patients treated for problems similar to their own so that they can gain a good perspective of what to expect.

And, of course, it is important to prepare patients for the prospect of preparatory orthodontic treatment seemingly worsening their appearance as the teeth are prepared to harmonize with the surgical protocol but that the final post-surgical result will provide the desired favorable changes.

Good understanding and cooperation between patients and all treatment team members is a key element in successful therapy.

#### • **Evaluation of facial aesthetics**

Practitioners evaluate facial aesthetics from both frontal and profile aspects. They then inform patients that their orthodontic-and orthognathic treatments will change their visages almost always in the direction of harmonizing facial equilibrium that is in improving both their frontal and their profile appearances. In particular, the treatment team must evaluate the three stages of the face (frontal, median third, and chin) in estimating their respective lack of balance in the frontal and sagittal planes and their possible asymmetries in the frontal plane.

The important points in the esthetic evaluation of patients are:

- Bilabial contact at rest and the possible distance that separates the two lips in a perfectly relaxed visage. When patients cannot easily close their lips at rest, when they close them forcibly that leads

to a contraction of chin muscles that gives the visage a strained look;

- The existence (or lack of) a gummy smile that is considered unsightly when it is excessive;
- The presence, or lack of, midline symmetry of upper and lower anterior teeth and the position of chin; The initial assessment is always supported by standardized photos of the visage in frontal, and right and left three quarter and profile views as well as by complete intraoral photographs.

#### • Radiological assessment

X-rays taken include a profile cephalogram, a panoramic film, and full mouth periapical series taken with long cone technique.

Examiners can assess basal bone in its antero-posterior and vertical aspects from a profile cephalogram. Numerous methods, including the Delaire, Downs, Steiner, Ballard, Sasseoni, and Ricketts analyses are available for making precise antero-posterior calculations of mandibular and maxillary basal bone anomalies and for studying facial divergences in the vertical plane; all elements critical for elaboration of a treatment plan.

The frontal cephalogram is used to evaluate asymmetries.

With the panoramic radiograph, examiners can make a rapid assessment of possible dental caries, areas of infection, and the presence of impacted teeth but this X-ray does not replace the full series of periapical films. If an osteotomy is contemplated, any necessary third molar removals should be performed six months before the scheduled procedure so that the extraction sites, which are the zones of the osteotomy

osseous consolidation, can fill in before surgery or, as an alternative, the surgeon can remove wisdom tooth buds as an initial step in the osteotomy. Dentists must place the dentitions of patients scheduled for preparatory orthodontic treatment in excellent condition by extracting all non-restorable teeth, making appropriate restorations for all teeth requiring them, executing a scrupulous prophylaxis, and performing periodontal or endodontic treatment where indicated.

The great strides made in recent years in the use of *cone beam computed tomography* and the development of three-dimensional software programs for assessing the mandible and the maxilla, as well as the development of pre-operative simulation techniques have all contributed to the probable imminent elimination of profile cephalograms as surgical evaluation tools.

#### • Evaluation of the occlusion

Examiners assess patients' occlusions in all three planes of space, antero-posterior, transverse, and vertical in establishing one of the fundamental elements for formulating a treatment plan. To accomplish this and document any possible dento-maxillo-facial anomalies they must establish a stable maxillo-mandibular reference position. When asymmetries seem to be present they must be careful to detect the presence of false or functional bites that may be causing false lateral positions of the mandible.

They must carefully explain to patients before preparatory orthodontic treatment begins that this phase of decomposition and coordination of the

arches will often tend to exaggerate occlusal discrepancies, at least in the antero-postero sense, and give the appearance that therapy has gone awry so that patients won't be discouraged by this necessary pre-operative stage.

Dentists should not undertake occlusal equilibration, especially when ill-fitting crowns are present, until the removal of orthodontic appliances. Placement of implant, if needed, should also be deferred until the end of treatment.

- **Evaluation of the TMJ and of functional problems**

Before any treatment is undertaken dentists should assess the action of the TMJs in relation to occlusion in opening and closing of the jaw and in antero-postero, vertical, propulsive, and diduction movements. Dentists then list symptoms associated with the TMJ so that they can be considered schematically in an orthodontic- and orthognathic treatment designed to stabilize, even eliminate TMD problems by equilibrating occlusal forces, except in the rare instances when it aggravates them.

In order to search for a possible nasal obstruction, an examination of the nasal fossas must be made and completed by a nasofibroscopy. If symptoms suggest the presence of a nocturnal ventilatory obstruction, a ventilatory polygraph will be needed. In some cases where there is marked nasal deviation, a correction of the septum can be carried out a few months before the planned osteotomy because minor septal deviations can be corrected during a Fort 1 osteotomies more serious ones cannot. They re-

quire an adapted pre-prepared pathway performed under videoscopic control through an endonasal route.

The orthodontist studies the posture and volume of the tongue at rest and during deglutition to discern possible abnormal swallowing that would require re-education that would, most frequently be undertaken at the end of treatment. However, in some cases it is advisable for speech therapists or kinesitherapists to begin it before or during orthodontic therapy.

In our practice, during the first consultation we discuss with the patients the three fundamental building blocks that assure the effectiveness and stability of this type of surgico-orthodontic therapy: surgery and orthodontics that are intimately coordinated but most, independently achieve certain goals, and also the re-training of tongue posture and of swallowing that are the patient's life-long responsibility, any lapse of which could provoke relapse of the original malocclusion.

The functional evaluation, which is as important as the occlusal and esthetic evaluations, requires a good understanding of the functions of ventilation and of speech. The objective of our protocols is not just to have obtained a good result at the time of removal of orthodontic appliances but one that will stand the test of time by having eliminated bad habits and ventilatory anomalies.

At the end of various therapy stages, we review our treatment plan with the patient in conjunction with all members of the treatment team. It seems to us essential that we gain the confidence of patients during the

initial consultation and also their complete agreement with and cooperation with an arduous and lengthy protocol.

### 3 – 2 – Classification of anomalies and position of teeth in the smile

We describe the principal anomalies of position of teeth in the smile below in terms of an “extra-oral” surgical clinical approach to the lower third of the face, site of the principal action of the orthognathic surgeon. This is an arbitrarily chosen vertical approach to the frontal visage of the face; any sagittal anomalies, the visage of the profile, are almost always combined and coordinated with frontal faults. The lower third of the face is itself divided into three stages. We deal first with the superior third and next correct the lower two thirds (Fig. 1).

- **Disharmony of the upper third**

It is imperative that any management of these anomalies must include a surgical procedure for the maxilla.

- **Gummy smile** All smiles that reveal more than two mm of gingiva are included in this category. This gingival exposure lends a somewhat comical character to a person’s visage, which, if pronounced, can be upsetting to that individual. Patients of North African and Spanish descent are particularly sensitive on this subject. Many adults have consulted us about an occasional gummy smile that is not associated with an occlusal anomaly. Psychological management of these patients must be executed with extreme care because their goal is exclusively esthetic and the

morphological change will be critical. Furthermore, the transformation of the visage generated by surgery will modify the patient’s personality in the eyes of others because they will have lost their comical facial expression.

- **Insufficient smile:** The upper incisors are not visible over their entire length making the smile look older than he actually is. Sometimes these patients have had premolars extracted as a component of orthodontic treatment in an effort to avoid surgery but were not satisfied with the result. If any adjustment of maxillary vertical dimension is contemplated, the surgeon will have to use bone grafts in order to avoid an unstable result, one readily subject to relapse.
- **Crowding:** which gives the smile a disorderly aspect. Surgical expansion of the maxilla ultimately associated with corticotomies, may make it possible for the treatment team to avoid extracting teeth.
- **Latero-maxilla, or maxillary asymmetry:** which can result from agenesis or loss of teeth unilaterally (the term “latero-maxillo,” widely used by surgeons does not actually exist in accepted nomenclature, unlike the term “latero-mandible.” Latero-maxilla refers to asymmetries of the upper arch with a discrepancy between the upper midline and the sagittal midline of the visage.) In contrast to the mandibular midline, which is unnoticed in a smile, an off-center maxillary midline can be quite unattractive. If orthognathic surgery is contemplated, there is no need for the orthodontist to attempt to correct this discrepancy.

- **Tilting of the maxillary occlusal plane:** this anomaly of position of the teeth in the smile, which tongue thrusting can cause, is particularly unsightly. Frequently teeth in this posture can become stiffed. To correct this tilting the treatment team must deal with its every aspect otherwise instability and relapse are possible.

- **Disharmony of the lower third**

It is imperative that management of these anomalies includes surgery of the mandible and/or of the chin area.

- **Latero-mandible:** With the mandible displaced toward one side, there is usually a discrepancy between upper and lower midlines. This type of smile problem requires

unilateral or bilateral osteotomy, sometimes associated with osseous adjustment of the chin area.

- **Excessively marked** If the labio-chin groove is too deep and, as often happens, is associated with a short lower third of the and a Class II division 2 malocclusion, the visage will present a closed and hostile aspect. So surgeons lower chin with the aid of a bone graft in conjunction with mandibular surgery.

In cases of combined anomalies of insufficiency or excess or upper and lower stages, we usually do both maxillo and mandibular surgical procedures.

## 4 – SURGICAL TECHNIQUES

The principal osteotomy techniques include segmentary and complete osteotomies of the maxillary table and the mandible, and also the more recent technique of single interdental corticotomies, all, except the corticotomies, performed under general anesthesia with naso-tracheal intubation. Surgeons always gain access intraorally thus leaving no visible facial scars. The choice of the surgical approach employed depends on the established treatment plan but may be modified during the course of preparatory orthodontic treatment in accordance with occlusion achieved by orthodontic forces and residual growth potential.

### 4 – 1 – Mandibular osteotomies

- **Epker's trans-ramal sagittal osteotomy**

Epker modified the original mandibular trans-ramal osteotomy that Dalpong and Obwegeser described by proposing an internal corticotomy incision on the ramus in a lower position than those of his predecessors, at a point facing the Spix spine where the mandibular nerve enters the mandible<sup>4,5</sup>.

And it is in the mandible that surgeons most frequently employ this intervention where its objective is to separate the dental arch and the two rami from the body of the mandible, while always respecting the osseous passage of the inferior alveolar nerve. The nerve's route starts buccally behind the upper lip in the form of a bird's wing so that it can take a V-Y shape as the lips close. The osseous incision line is more or less high, situated in the position that best

allows the surgeon to mobilize the maxillary sector for advancement, impaction, lowering, distalizing, or re-centering in cases of rotation or whatever other position is desired. The specific risk for this procedure is that the anesthetized palatal pedicle will have sequellae affecting the palate and the upper teeth.

For adults and some other patients with narrow palates, it may be advisable to use surgically assisted rapid palatal expansion before the major surgery to gain the required transverse width. This procedure demands the same surgical time as a Le Fort 1 but not the lowering of the maxillary table.

- **Schuchardt segmented osteotomy**

With this osteotomy surgeons can essentially mobilize the premolar molar segments bilaterally with the goal of intruding them to correct an anterior open bite. They can also tilt crowns buccally or palatally as a separate procedure or in conjunction with intrusion of the maxillary table. The specific risk of this procedure is that it might cut off the vascular supply of the posterior teeth. But with the new possibilities of orthodontists moving teeth in hitherto impossible ways thanks to anchorage supplied by miniscrews and the introduction of corticotomies, the need for this type of segmented osteotomy has greatly diminished.

- **Wassmund's segmented osteotomy**

With this osteotomy and the accompanying extraction of the upper first bicuspids, surgeons can retract the incisor-canine bloc. With it they can also tilt those anterior teeth labially or palatally as a single proce-

dure or as a component of the retraction. Surgeons begin this procedure by first by making two buccal vertical incisions near the necks of the first premolars to gain access to the piriform orifices by tunneling through the fibro-mucosa at the junction of the maxilla and the premaxilla. The osteous section requires delicate touch from surgeons especially since the access view is so limited. This type of osteotomy demands an intimate collaboration between surgeon and orthodontist up until and after removal of the arch wire at which time a splint prepared on a set-up can be used as means of setting and supporting bony fragments until plates can be screwed into place to control osteosynthesis. The improvements of orthodontic capabilities thanks to secure anchorage have also reduced the indications for this type of osteotomy. The specific risk for Wassmund procedure is relatively frequent loss of nervous sensation of the anterior bloc of teeth.

## 4 – 2 Corticotomies

A relatively recent surgical technique is the creation of superficial unicortical alveolar corticotomies, around individual teeth, before the application of orthodontic forces to them as a means of accelerating their movement. These delicate incisions pass mesially and distally to the buccal and palatal borders of the alveolus around the teeth at 3 mm below the root apices<sup>2,3,6</sup>. Surgeons must be careful not to abuse medullary bone surrounding the periodontal ligaments of affected teeth. Thus liberated, teeth move rapidly in response to light

forces, applied, preferably to self-ligating brackets. These corticotomies can be performed in conjunction with the pre-orthodontic extraction of wisdom teeth or surgically assisted rapid palatal expansion. At the present time corticotomies conducted with the minimally invasive technique of piezosurgery are enjoying a major surge in usage and, in our opinion deservedly so, because we have found they cut treatment time in half.

#### **4 – 3 – Follow-ups to surgery**

Modern orthognathic surgery, which patients tolerate quite well, requires a one to two day hospital stay for one jaw procedure and two to three days for surgery of both jaws.

Post-surgery status of patients is usually uneventful and if pain persists it is easily controlled with mild analgesics. Moderate facial edema, of varying intensities, usually peaks 72 h after surgery and disappears after about ten days. Most patients do not require post-operative fixation of the jaws, loose, easily removed, intermaxillary elastics usually suffice. Because post-operative oral hygiene is important, patients are asked to clean their teeth with a water jet type of appliance in addition to a surgical toothbrush beginning the morning after the procedure. They can eat only liquid foods for a week, then soft foods for the next ten days. Four to six weeks after orthognathic surgery patients can resume a normal diet.

### **5 – COMPLEMENTARY TECHNIQUES AND CLINICAL CASES**

Surgeons may want to use supplementary surgical procedures after orthognathic surgery in order to improve aesthetics of the visage.

#### **5 – 1 – Rhino-septoplasty**

While an endo-nasal septoplasty may sometimes precede orthognathic surgery must follow it for the same reason that a builder does not construct the roof before pouring the foundation. Similarly the nose is supported by the maxilla and its correction must await the surgical adjustment of the upper jaw. Some surgeons perform the rhinoplasty in the same session the orthognathic procedure is accomplished but we do not agree with this combination because sur-

gery of basal bone requires nasal intubation, which makes endo-nasal access for a rhinoplasty difficult. Moreover, the edema provoked by separation of the rising branches of the maxilla and the osteosynthesis following a Le Fort 1 procedure make any nasal surgical procedure imprecise and risky. Surgeons can safely undertake this intervention designed to complete the esthetic improvement of the visage 8 to 12 months after removal of the orthodontic appliance (Patient n° 3).

#### **5 – 2 – Injection of centrifuged fatty tissue and filler**

The injection of centrifuged fat, or lipostructure, that Coleman first

described, can be used to improve the appearance of the visage or, as Coleman put it, apply rejuvenation in a syringe, especially in the zygomatic area. It must be done at a safe distance from the site of the osteotomy and can be performed at the same time as the rhinoplasty. Other synthetic filling materials, such as hyaluronic acid, polylactic acid, or botulin toxin have been used for esthetic purposes, such as wrinkle removal, with well documented good, but relatively short lasting results.

### 5 – 3 – Osseous apposition and sinus filling

Alveolar osseous grafts, which are used for edentulous areas, can be completed before surgery as is done for sinus filling that must be completed before a Fort 1 is started or after removal of orthodontic appliances.

Implantologists, prosthodontists, and technicians who construct set-ups on articulators most work in close collaboration in treating complex edentulous cases by following a carefully defined treatment plan but the implants themselves are almost never positioned until all other treatment is completed.

### 5 – 4 – Clinical cases

- **Patient n° 1**

Gummy smile, with excess anterior dimension with no occlusal anomalies. Patient wanted only esthetic improvement. With the cooperation of Dr. De Papé of Paris we prepared an orthodontic-and orthognathic treatment that

called for a bimaxillary osteotomy and a genioplasty. Before and after facial and intraoral photographs are shown below in Figures 2 and 3.

- **Patient n° 2**

Gummy smile, with excess anterior vertical dimension and no malocclusion. She wants only esthetic improvement. Our orthodontic-and orthognathic treatment, to be performed in collaboration with Dr. Bedar of Drancy, calls for a bimaxillary osteotomy and a genioplasty (Fig. 4).

- **Patient n° 3**

Insufficient smile, Class II dental and skeletal. Our orthodontic-and orthognathic treatment, to be completed with collaboration of Dr. Popelut, of Melun, called for bimaxillary osteotomy, autologous bone grafts, and then a rhinoplasty. Frontal, profile, and three quarter photos (Fig. 5) and intraoral photos (Fig. 6).

- **Patient n° 4**

Insufficient smile, Class II dental and skeletal. Our orthodontic-and orthognathic treatment, to be completed with collaboration of Dr. Ohana-Toledano, of Suresnes, called for bimaxillary osteotomy and autologous bone grafts. Photographs of the face (Fig. 7) and intraoral photos (Fig. 8).

- **Patient n° 5**

Crowding of teeth, in a Class II skeletal and dental malocclusion with maxillary asymmetry and a mandible that was laterally displaced after it was fractured when she was a child. . Our orthodontic-and orthognathic treatment, to be completed with collaboration of Dr. Bedar of Drancy maxillary palate splitting, corticotomies, bimaxillary osteotomy, and a genioplasty. Facial photos (Fig. 9) and intraoral photos (Fig. 10)

*Figure 2*

*Frontal, profile, and three-quarter views of patient n° 1 before treatment (left column) and after bimaxillary osteotomy, and genioplasty (right column).*

*Figure 3*

*Patient n° 1, intraoral photos before treatment (upper row) and after treatment (lower row).*

- **Patient n° 6**

Class III dental and skeletal malocclusion with maxillary asymmetry. Our orthodontic-and orthognathic treat-

ment, to be completed with collaboration of Dr. Sassoong-Marciano, of Paris, called for bimaxillary osteotomy and



Figure 4

Patient n° 2, frontal, profile, and three-quarter photos, before treatment (left columns) and after bimaxillary osteotomy and genioplasty (right columns).

genioplasty. Photographs of the face (Fig. 11) and intraoral photos (Fig. 12).

#### • Patient n° 7

Class III dental and skeletal malocclusion with tilted occlusal plane. Our orthodontic-surgical protocol, to be completed with collaboration of Dr. Serfaty, of Paris, called for bimaxillary osteotomy. Photographs of the face (Fig. 13) and intraoral photos (Fig. 14).

#### • Patient n° 8

Excessively deep groove between chin and lower lip. Class II dental and skeletal malocclusion. Our orthodon-

tic-and orthognathic treatment, to be completed with collaboration of Dr. Sassoone-Marciano, of Paris, called for mandibular osteotomy, genioplasty, and autologous bone grafts. Photographs of the face (Fig. 15).

#### • Patient n° 9

Class III dental and skeletal malocclusion with mandible displaced laterally. Our orthodontic-and orthognathic treatment, to be completed with collaboration of Dr. Serfaty, of Paris, called for a mandibular osteotomy. Photographs of the face (Fig. 16) and intraoral photos (Fig. 17).



Figure 5

Patient n° 3 frontal, profile, and three-quarter photos, before treatment (left columns) and after bimaxillary osteotomy with bone grafts, genioplasty, and rhinoplasty (right columns).



Figure 6

Patient n° 3, intraoral photographs before treatment, with appliance in place (upper row) and after treatment (lower row).



Figure 7

Patient n° 4, full face, profile, and three quarters photos, before in the left columns and after bimaxillary osteotomy, and genioplasty with bone grafts, in the right columns.



Figure 8

Patient n° 4, intraoral photographs before treatment, with appliance in place (upper row) and after treatment (lower row).

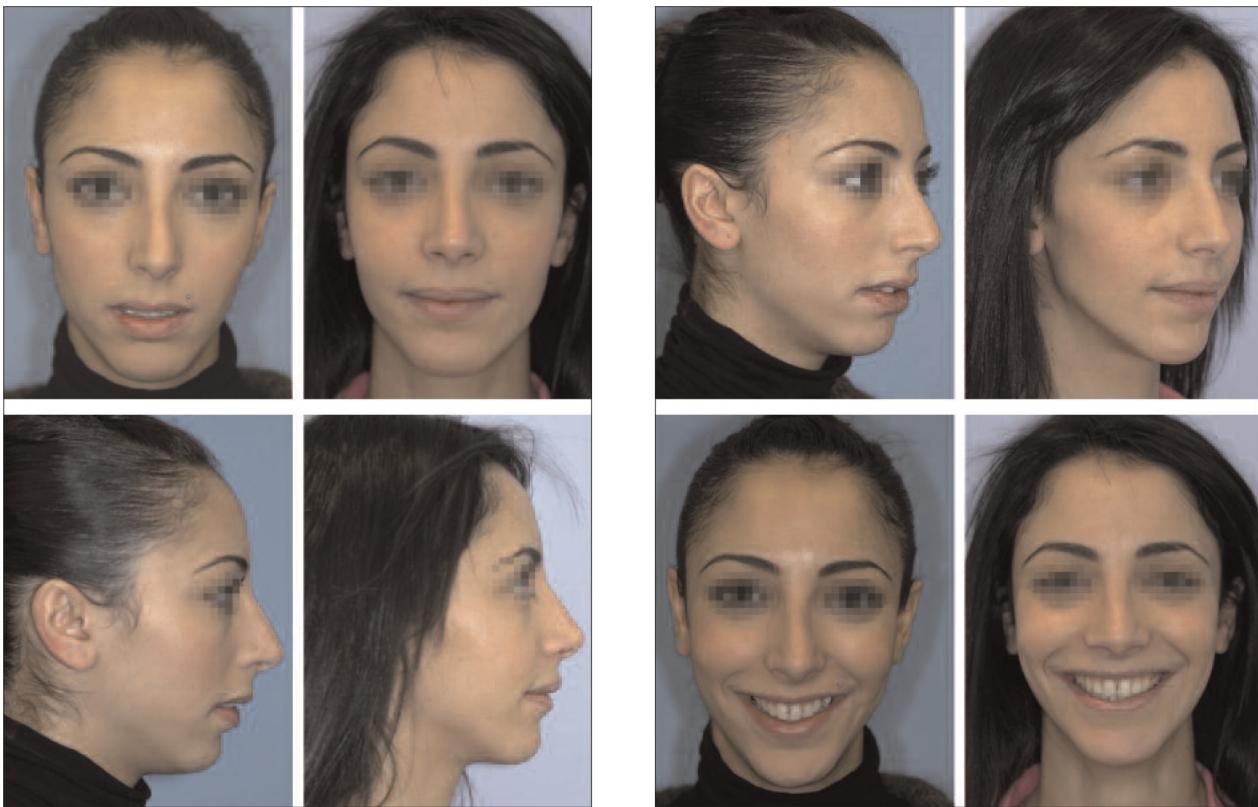


Figure 9

Patient n° 5 frontal, profile, and three-quarter photos, before treatment (left columns) and after bimaxillary osteotomy preceded by corticotomies (right columns).



Figure 10

Patient n° 5, intraoral photographs before treatment, (upper row) and after treatment (lower row).



Figure 11

Patient n° 6, frontal, three quarters, and profile photos before treatment (left columns) and after bimaxillary osteotomy (right columns).



Figure 12

Patient n° 6, intraoral photos before treatment, with appliance in place (upper row) and after treatment (lower row).



Figure 13

Patient n° 7, frontal, three quarters, and profile photos before treatment (left columns) and after bimaxillary osteotomy (right columns).



Figure 14

Patient n° 7, intraoral photos before treatment, with appliance in place (upper row) and after treatment (lower row).

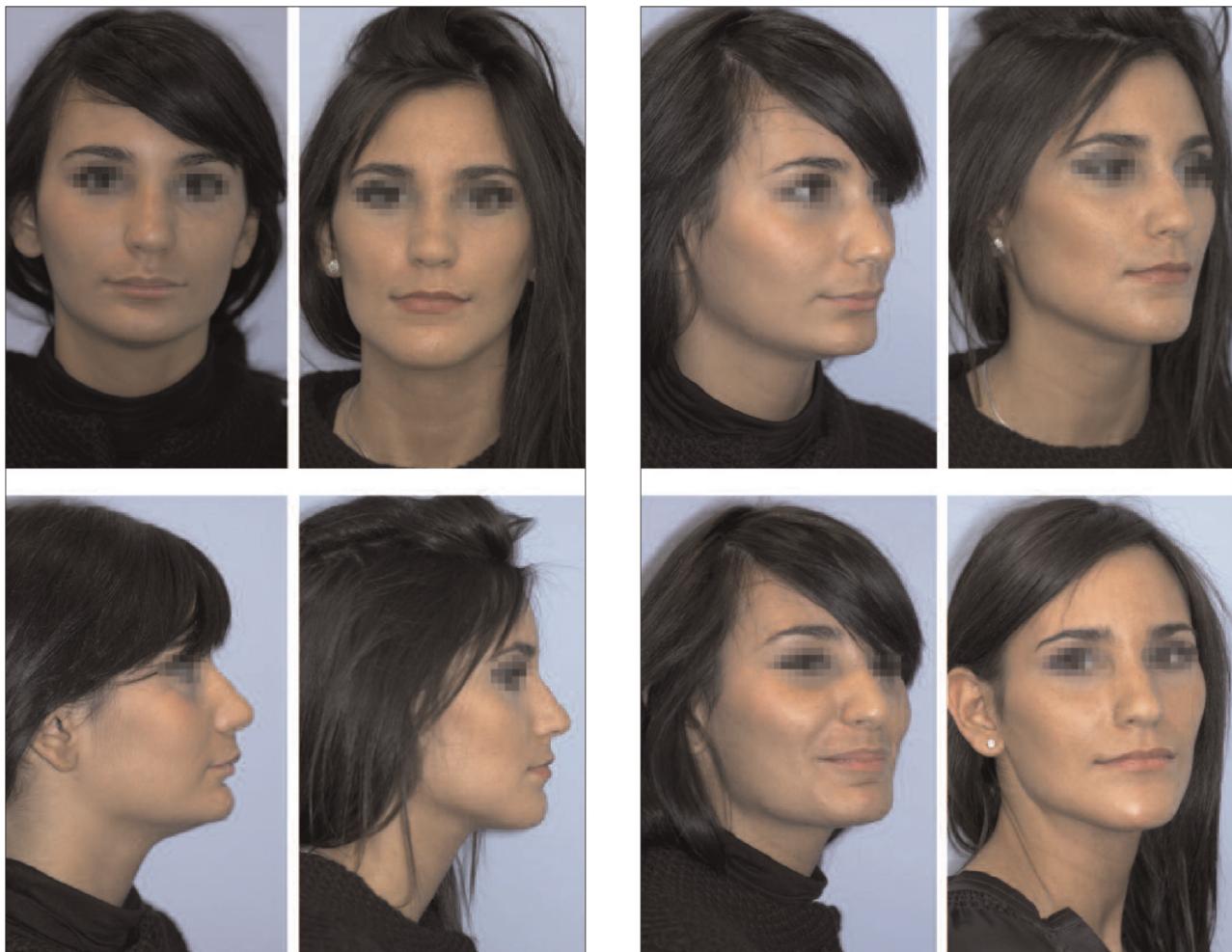


Figure 15

Patient n° 8, frontal, profile, and three-quarters facial photographs before treatment (left columns) and after mandibular osteotomy and genioplasty with bone grafts (right columns).

## 6 DISCUSSION AND PERSPECTIVES

### 6 – 1 – Orthognathic surgery and facial aesthetics

In modern orthognathic surgery esthetic values are given as much consideration as problems of occlusion and of basal bone. Treatment plans are no longer established to deal exclusively with occlusal discrepan-

cies but are also based on understanding of and assessments of the anatomy of the bones and soft tissues of the face, particularly with regard to the nose whose cartilaginous structure is supported by the maxilla. As an example of the issues involved, we know that for the same amount of surgical advancement of the maxilla



Figure 16

Patient n° 9, frontal, profile, and three-quarters facial photographs before treatment (left columns) and after mandibular osteotomy (right columns).



Figure 17

Patient n° 9, intraoral photos before treatment, (upper row) and after treatment (lower row).

the consequences for the nose are quite different for the visage of a Caucasian than they are for the visage of a Black. For Blacks, the point of the nose is essentially cutaneous and derives only modest support from the cartilaginous septum and the inferior lateral cartilages. The consequences for Blacks of maxillary advancement are often, accordingly, an enlargement of the wing of the nose and a lowering of the nasal tip with closing of the naso-labial angle, which is highly unaesthetic. It is therefore necessary for Blacks with Class III dental and skeletal malocclusions to be treated with surgical setback of the mandible rather than by maxillary advancement. For the Caucasian visage, on the other hand, the rigidity of the inferior lateral cartilages and the support of the septum have a tendency to project the tip of the nose forward and open the naso-labial angle during a maxillary advancement causing a positive esthetic result, if the advancement is not too great. It is for this reason that in cases of severe mandibular prognathism, it is best for surgeons to devise a treatment plan based on a bimaxillary osteotomy with a modest maxillary advancement combined with a modest mandibular set-back rather than a strong maxillary advancement (see Fig. 13, with its profile photographs of patient n° 7 who did not have a rhinoplasty).

Treatment plans for this type of surgery must be highly individualized, based on a careful clinical and esthetic analysis of each patient.

It is useful to examine examples of another circumstance in which esthetic considerations should take preference over functional issues, the

insufficient smile. We believe that antero-posterior malocclusions without open bite, whether they are Class II or Class III, have little tendency to relapse because of faulty tongue posture or action, if the growth period has ended. For these patients, the labial and masseter muscle bundles are often hypertonic. For some of them it might be advisable to concentrate on stability and esthetic improvement even without achieving lip contact at rest. So, in certain judiciously selected cases to leave the lips parted after conclusion of surgical-orthodontic treatment. Take for example patient n° 3 (Fig. 5) who had presented with an excessively short upper lip associated with an insufficient smile. In order to ameliorate her smile, a maxillary bone graft was required and, eventually, a rhinoplasty was performed. A satisfactory result was achieved but, at rest, her lips remained slightly parted. A year and a half after removal of orthodontic appliances, her occlusion remains stable and she is still fully satisfied with the esthetic result achieved.

## 6 – 2 – Perspectives

Many researchers are now assessing three dimensional cephalometrics using special software for incorporating scanner or cone beam data in their three dimensional reconstructions of maxillo-facial anatomic structures. The major benefit of these programs resides in the possibility of precisely planning osteotomy operative procedures, of using them to construct intermediary splints, and, thus, controlling operative positioning of the maxillae thanks to digital

surgical navigation. These systems are still in the development stage and remain too cumbersome for day to day practice but in our clinical department we are engaged of clinical studies of these three dimensional systems.

Alveolar corticotomies are an efficient method of reducing orthodontic treatment time. With them orthodontists can move teeth more rapidly with lighter forces. At the close of treatment, the osteogenesis that tran-

spires increases the stability of the result. But operative indications for corticotomies must be scrutinized carefully<sup>2,3,6</sup>. In our experience this minimally invasive, totally secure, and perfectly well tolerated approach provides a significant reduction of treatment time.

A protocol for a nationwide clinical hospital research program for corticotomies is currently active in France and its results should deliver precise prospective evaluations of this technique.

## 7 – CONCLUSION

Orthognathic surgery, today a distinct specialty of its own, depends for the smooth execution of its orthodontic-and orthognathic treatment on the intimate collaboration of all the member of its interdisciplinary teams.

In addition to that cooperation, the efficiency of that team effort requires from each team member mutual and progressively improving understand-

ing to the functioning of all the other participants.

For adult patients, esthetic considerations form the most important aspect of contemplated orthognathic surgery. So all team members must be prepared to coordinate their efforts to satisfy the aesthetic demands of their joint operation even if that requires their taking precedence over functional and occlusal objectives.

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