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Orthodontic–surgical strategy in 2016

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ABSTRACT

The fundamental basics of patient care, during orthognathic surgery, have been well known for several years. This therapeutic treatment requires cooperation between orthodontist and surgeon from the orthodontic preparation stage until the retention period. Over the past few years, the combined surgical and orthodontic protocols have undergone both an important technical and conceptual evolution, making them easier to tolerate with more stable results. The main explanation for this is more systematic consideration of the functional parameters involved in the treatment, leading to multidisciplinary care.

We found it interesting, in 2016, to update on this combined surgical and orthodontic therapeutic strategy.

KEYWORDS

Orthognathic surgery, maxillary osteotomy, mandibular osteotomy, orthodontic preparation, cooperation, combined surgical and orthodontic treatment

INTRODUCTION

Caring for patients in need of orthodontic–surgical treatment has been the subject of many articles. These articles have presented the fundamentals of this type of care, detailing the concepts of orthodontic–surgical collaboration or even orthodontic–surgical symbiosis[10,11,19]. These orthodontic–surgical treatments have considerably developed in recent years and this is attested by the exponential increase in the number of articles published on this subject. Techniques and concepts based on orthodontic–surgical treatments have developed. The common denominator is the multidisciplinary approach that constitutes the foundation of the conventional orthodontic–surgical collaboration.

Thus, orthodontists and surgeons have to make room in their respective practices for other disciplines. The purpose of this article is to retrace the lines of this recent evolution through a global synthesis of different treatment phases. This synthesis therefore serves as the basis for modern orthodontic–surgical procedures.

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FIRST CONSULTATION: CIRCUMSTANCES SURROUNDING THE PROCESS

The first consultation, whether with an orthodontist or a surgeon, is a crucial step in treatment. Circumstances leading to a patient's medical process, as well as patient motivation, will have an undeniable effect in the progression of treatment given that the initial contact can condition the patient's acceptance or refusal of the proposed treatment[32].

If the process is initiated by the patient, this serves as a good gauge of the patient's motivation and is synonymous with commitment to the treatment plan. In Figure 1, it is still necessary to properly assess the request or even the "desire" of the patient and to ensure that it corresponds to reality so that the patient does not develop false hope[18,29,30,32].

In other situations, particularly with younger patients, the process is initiated by the family. What is required in this situation is to ensure that your thoughts and feelings empower and push them to take an active role in making an appropriate decision. The practitioner must not settle for the parents' commitment as evidence of the patient's mindset but must find the simplest way possible to make the young patient more willing to participate in the process so that the patient is more motivated to undergo the procedure.

Lastly, the process can be initiated by another practitioner, a dental surgeon, or most often, a general practitioner. When this is the case, information given by the professional must be complete and verified. The same holds true instances when the patient is referred by "new correspondents" from non-traditional, specialties associated with the field of orthodontic surgery. These include ENT specialists, sleep doctor, cardiologists, pulmonologists, pediatricians, kinesiologists, speech–language pathologists, osteopaths, podiatrists, and general practitioners (fig. 1).

The patient often anticipates this first consultation and is searching for a concise response to their numerous expectations. In their presence, the practitioner must address these expectations, although the practitioner may not necessarily have all information available pending the initial assessment. The practitioner's address must therefore, in the ideal scenario, be complete and almost exhaustive and standardized. The practitioner must be able to tackle all aspects of treatment, while remaining realistic.

In concrete terms, this means explaining to the patient that the treatment is both functional and esthetic and that it will affect the patient's face (in frontal and profile views) as well as the mastication, periodontium, temporomandibular joints, tongue, respiration, posture etc. Data from the literature do not allow or promise the patient precise statistical information showing improvement of functioning; esthetic modifications are variable, and information will be differently perceived among patients.

The patient must therefore be informed that the attempt to obtain a good occlusion in a facially harmonious bone structure usually turns out well in most cases from a functional and esthetic perspective. Additionally, the patient should know that we

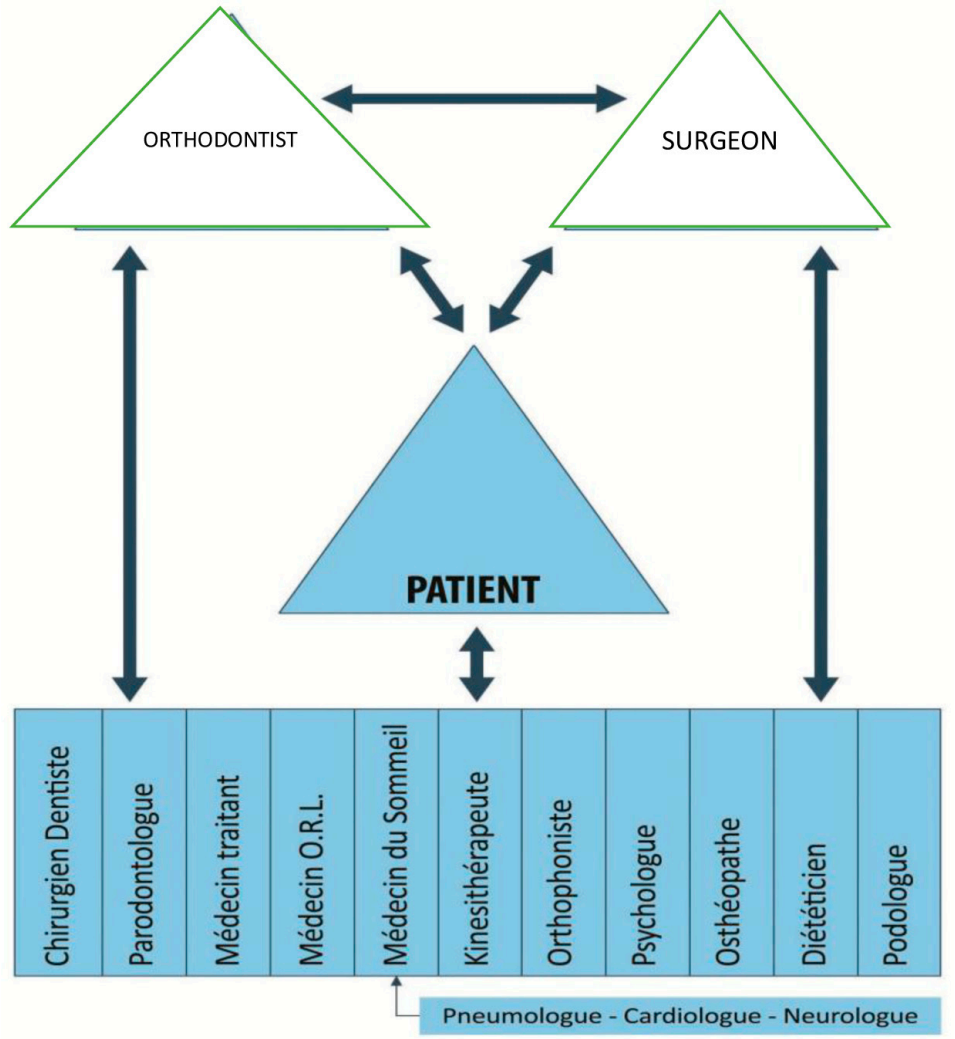

Figure 1: Multidisciplinary care. Chirurgien dentiste-dental surgeon, parodontologue-periodontist, médecin traitant- général practitioner, médecin du sommeil- sleep doctor, kinésithérapeute- kinesiologist, orthophoniste-speech–language pathologist, psychologue- psychologist, oestheopathe-osteopath, dietician, and podiatrist.

now have the means to assume responsibility for an unsatisfactory alteration both functionally and esthetically[5,18,29,30,32].

The patient should be informed at the beginning that complementary procedures such as rhinoplasty, genioplasty, and contour surgery may be required at the end of treatment. The treatment will progress more easily, and should an adjustment become necessary, the request will be more easily accepted by the patient. This is particularly important if further functional or esthetic intervention is necessary[39]. The initial address will provide the patient with a cost–benefit analysis to ensure that the patient has all information necessary to make a conscious decision. When weighing the "benefits," the patient will take into account the potential esthetic

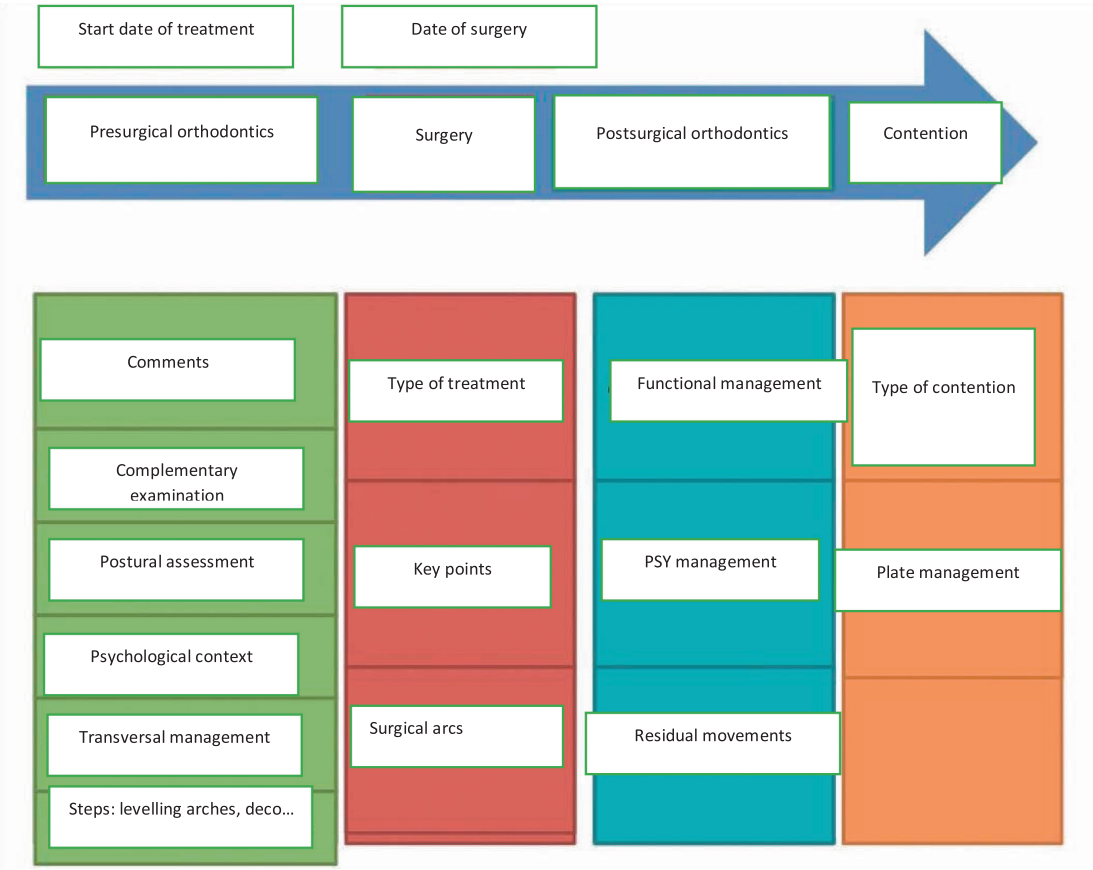

Figure 2: Computerized correspondence for an orthodontist and surgeon

and functional elements. When considering the costs, the practitioner will outline the constraints associated with orthodontic–surgical treatment.

In this phase, it is important that the practitioner gives the patient detailed information concerning their field, but they are limited to only giving an outline of the treatment provided by their colleague. Information concerning the surgical phase of the process will be better explained by the surgeon, and similarly, the orthodontist will better explain the orthodontic aspects

In this way, the risk of exaggerations, overestimations, and outdated information will be avoided. After this first consultation, the patient will have an idea that their orthodontist and their surgeon know each other perfectly and are in the habit of communicating and working together. This image of teamwork is a gauge of the quality and conscientious attitude that patients often look out for/seek out among members of their multidisciplinary team.

In our center, we are currently working on an information booklet that will be permanently available to and can be modified by the orthodontist and surgeon. It contains key elements concerning treatment, thereby facilitating dialogue and increasing the chances of holistic care and avoiding any misunderstanding (fig. 2).

DIAGNOSTIC PHASE

The diagnostic phase helps establish a treatment plan. The assessment conducted during this phase must be complete and systematic and should have addressed all structural and functional elements. This assessment can serve as a test to gauge the patient's motivation.

When the patient completes the entire assessment, this serves as proof that they are motivated and that they have understood the focus of all the different aspects. The first step of this assessment is standard, and it comprises the most precise clinical evaluation possible. The examination starts from when the lip line is at rest to the full smile and includes the frontal view of the face as well as the profile. However, in current practice, the practitioner will be more attentive to a certain number of clinical elements concerning the functional aspect of treatment. Modern orthodontic–surgical treatment places more emphasis on functional disorders linked to mastication, respiration, tongue, posture, etc. (fig. 3, 4, 5, 6).

Figure 3: Mastication problems linked to open bite.
Figure 4: Buccal respiratory syndrome.

Figure 5: Lingual dysfunction.

Figure 6: Posture problems.

Similar to the anamnesis, the clinical evaluation will check for any elements that can involve one or more of these functions. The practitioner must not hesitate to schedule a specialized consultation if required. These are now considerably easier to arrange due to the growing number of specialists in the fields of sleep, rehabilitation, posture, etc. for orthodontic–surgical patients. Standard elements such as photographs, impressions, and X-rays will help complete this clinical assessment.

It should be noted that the practitioner may have to resort to digital optical impressions because of the advantages of data storage and manipulation of the information of models, thereby allowing for more precise simulations. Likewise, performing three-dimensional (3D) or cone-beam scanning has become a current practice as it allows for an easy test for the existence of dysmorphia and is more precise.

These 3D X-rays facilitate the surgery by providing better visualization of nerve distances and osseous relationships. MRI analysis of the temporomandibular joints can be necessary in cases of a suspected dislocated disc. Note that the examination will be difficult to conduct once the patient is wearing braces.

With increasing frequency, if a resistance syndrome or sleep apnea is suspected during the initial examination, polysomnographic records are taken before ending the assessment. The evaluation of residual growth potential remains very problematic as the age of the person and their bone growth do not always coincide during puberty. Evaluation of the dental and periodontal states is also systematically conducted for treating adult or elderly patients

Treatment Plan

Once the assessment is completed, a treatment plan will be established and presented to the patient to make their decision[3,4,22,38,39]. The experience of the practitioner and "school" training received will have a direct impact on the treatment choice. However, some general rules are being enforced more often in recent times:

Allow the patient the independence to choose from all different options available and explain the therapeutic

alternatives even if the professional does not agree with them personally; the patient must also be allowed to ask for a second opinion if they so desire[5,18,29,30,32]

- Come to a decision in a more collegial manner by working in conjunction with the multidisciplinary team so that in the end, the treatment plan represents a common agreement that satisfies all functional and or esthetic criteria identified by the team.
- Previsualization of the treatment objectives reduces the incidence of simulations that are unreliable and not easily reproducible and tends to present the patient with examples that are as closely connected to their case as possible[17,31]
- To involve the patient's family or primary support person from this stage so that they will be prepared for the change and will be a good source of support to the patient rather than a source of worry or stress.
- To account for the transversal and vertical dimensions of treatment with their relative functional importance. This is being proposed more often and allows a more systematic correction even for slight anomalies[15,21,26,30].

The current trend is to under-correct a gingival smile and assign more importance to labial occlusion in the resting position; aging soft tissue has the tendency to cause tissue ptosis and therefore cause the upper lip to collapse over time (fig. 7).

Figure 7: Incisal overlap in the resting position and when smiling.

THERAPEUTIC PHASE

The major change in recent years concerning therapeutic sequences is to have the patient at the center of the treatment[5,18,29,30,32]. The different steps of treatment are coded as follows: orthodontic pre-surgical preparation, orthodontic surgery, and postoperative phase.

Traditionally, the patient was passive and endured the treatment. The patient took a more active role in the treatment. In effect, orthodontic–surgical treatment has developed with contributions of recent orthodontic and surgical techniques and the infusion of functional aspects. It has become a vital pillar of treatment[15,21,26,30]. Patients can therefore change care providers based on the choice of treatment. Moreover, the patient's participation in the functional treatment improves the quality and stability of the results.

Pre-treatment

Improved life expectancy and good health have pushed the boundaries of orthodontic surgery. With increasing frequency, orthodontic–surgical treatments are being recommended to adults as old as 65 years. Older people often need periodontal surgical preparation while more will require intervention for implant restorations[25,36]. From the very start, the coordination among all practitioners is fundamental and strongly advised to ensure that all parameters are included. The inclusion of the general practitioner or periodontist at the beginning of treatment directly influences the result and even the smooth progression of treatment. Thus, orthodontic anchorage failure can sometimes be resolved by early implantation. Gingival grafts and periodontal sanitizations have become commonplace[25,36].

Pre-operative orthodontics[13]

The orthodontist will have to prepare the arches so that they do not interfere during intermaxillary blocking. The therapeutic strategy will achieve four objectives:

- To correct dentomaxillary harmony.
- To level the arches to allow for the insertion of surgical arcs to support postoperative blocking.
- To decompensate the arches in the three dimensions of space
- To plan the final occlusal position of the maxillary and mandibular arches so that they correspond during surgery.

To achieve this goal, we now possess innovative and effective therapeutic means which, in the future, will allow for a range of movements within the alveolar bone. This modern decompensation is an important innovation and its only limitations may now be purely surgical.

Orthodontic surgical cases are now more frequent and have a better success rate. Among these innovative means, we will cite configuration and digital surgical splints, plates and miniscrew anchorages, customized vestibular and lingual attachments, and finally, the valuable assistance of the kinesiologist and speech–language

pathologist to treat oral function in the preoperative and postoperative stages.

Configuration and digital surgical splints (fig. 8)

Scale models are used to prefigure the final result while confirming the sufficiency of stripping or the need for extractions as predicted by the orthodontic treatment plan for structuring the arches. The configuration also provides a benchmark for the practitioner during preparation. With the advent of digital impressions and computer software's such as Orthocad and Neoanatomy Design, the orthodontist can avoid the stages of plaster molding and mounting models on an articulator. This saves times and facilitates easier communication within the multidisciplinary team.

Unfortunately, patients would have to wait a few years for the software to be precise and more affordable. Manipulating these tools still requires a long period of learning, and the practitioner's experience remains indispensable. Similarly, computer software's permit the simulation of orthodontic results on the profile. A photograph and a teleradiological image of the profile are superimposed after calibration. Then, supported by statistical values, the software simulates changes to bone and skin patterns according to therapeutics (extractions, surgery, etc.).

However, there is a problem when reproducing the data. Finally, the surgical splints created after orthodontic preparation allow the orthodontist and surgeon to achieve surgical simulation on models because of innovative software's such as Model Viewer. A 3D design of the splints is now possible; this is followed by creating an impression of accurate, surgical

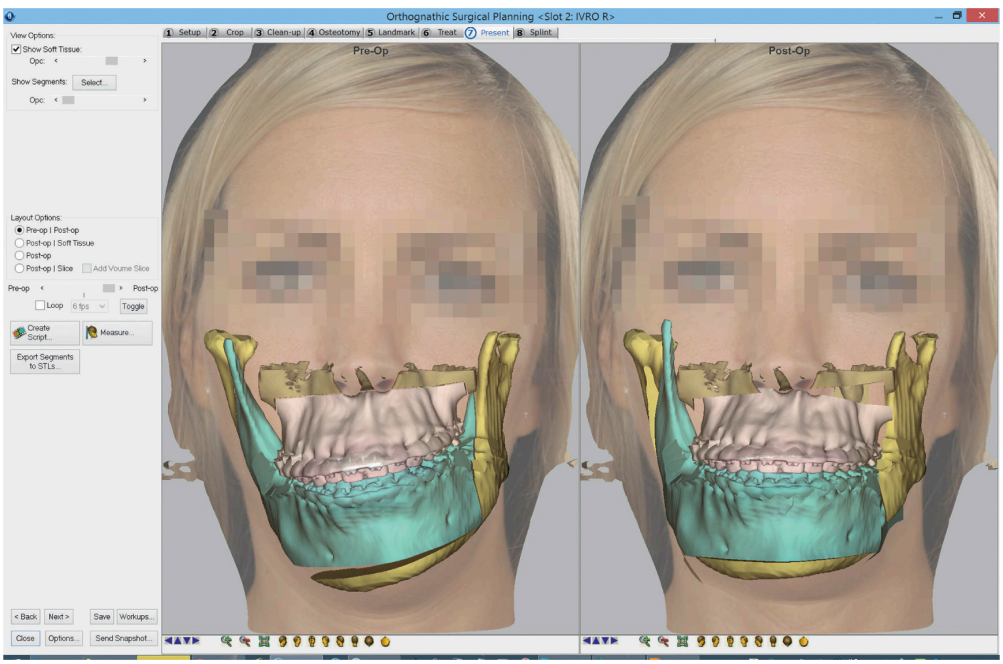

Figure 8: Computerized configuration (Dolphin Imaging).

resin splints, which can be quickly made and are easy to archive. This digital evolution is also fundamental to orthodontic techniques based on the sequential transmission of a series of splints that were digitally preconceived (Invisalign).

All digital techniques are still being perfected and are not available for current use; however, they will be available in the future.

Plates and miniscrew anchorages

These are widely used in orthodontics to achieve a range of movements without affecting the other teeth in the arch. Therefore, they optimize orthodontic preparations and achieve compatibility between any occlusal and skeletal discrepancies before the patient undergoes surgery of the baseline bones (fig. 9).

With the help of two palatal miniimplants of 1.8 to 2.2 mm in diameter and 7 to 8 mm in length, according to the maxillary cone-beam analysis, we can achieve a traditional disjunction with a Hyrax expander connected to the molar braces. This disjunction can be surgical, depending on whether a major skeletal expansion is needed or if the purpose is only to preserve the dental supports. Lastly, this disjunction can be achieved in a single surgical intervention concomitant to sagittal intervention.

Figure 9: Intermaxillary disjunction on miniscrews.

The advantage of this technical advancement, as seen here, is to reduce costs and to comfort patients, particularly those affected by obstructive sleep apnea syndrome for which correction often requires initial surgery to surgically expand the maxilla and then perform double maxillomandibular advancement.

Regarding the anchorage plates, there are many such plates at our disposal. They can be placed during a complementary surgical procedure (disjunction or disinclusion for example), particularly when the orthodontic preparation needs a complete arch movement (symmetrical or asymmetrical, maxillary or mandibular). The advantages of these plates compared to miniscrews are the avoidance of all interference with the roots of the teeth. Further, the application point of force is close to the center of the arch. Therefore, the induced movement will be effective, continuous, and reliable and will not disturb the patient in any way (fig. 10).

Customized brackets (fig. 11)

Independent of whether the techniques are lingual (Win®, Incognito®, Harmony®) or vestibular (Insignia®), CFAO has manufactured personalized brackets that will be positioned precisely at the end of treatment using indirect bonding. The arches will be controlled in terms of their concordance as well as dental axes, which are individualized and studied in the attachment design step. Moreover, personalized arcs, also made by CFAO, are used as a supplementary

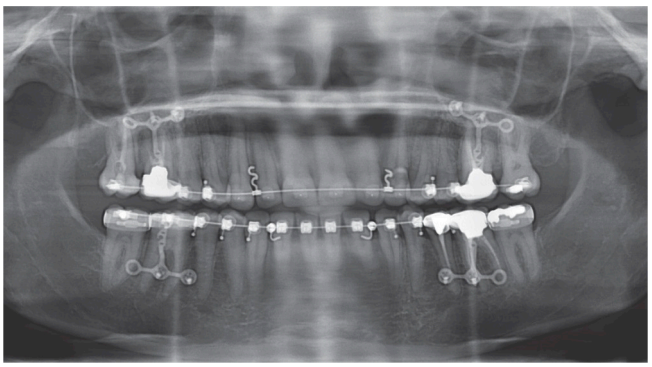

Figure 10: Anchorage plates.

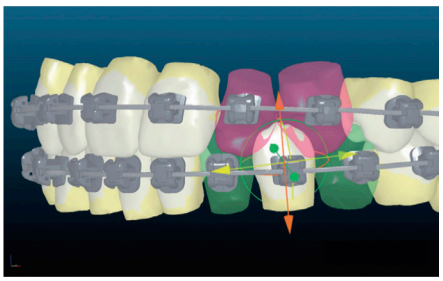

Figure 11: Customized brackets (Insigna Ormco).

aid to obtain the final result that was predefined and approved by the multidisciplinary team.

Pre- and postoperative treatment of oral functions

The stability of the desired dentoskeletal balance is conditioned by restoring the balance of perioral functions such as ventilation, phonation, mastication, and particularly deglutition[15,16,21,26,30].

Therefore, kinesiological treatment must be integrated into orthodontic–surgical treatments and implemented in the pre- and postoperative stages.

Even the integration of the functional dimension in the orthodontic phase is appropriate as it is becoming a popular practice for the orthodontist to factor in tongue placement, labial occlusion, and nasal respiration, with fewer extractions and more expansion as a result[1,2,15,16].

Surgery

Orthodontic surgery has advanced considerably in recent years, profiting from technological advances, notably that of piezosurgery[6,28], and also the development of new or updated technical procedures. More often, surgery takes place from the first phase of treatment; therefore, these technological advances provide more assistance to the orthodontist from the initial preparatory phase.

Beginning treatment

During the presurgical orthodontic preparation, recent techniques can be proposed to facilitate the work of the orthodontist.

- Corticotomies[14,27,34]

A less invasive procedure that by creating multiple lines or peri-radiculodental bone punctuations will stimulate blood flow, thereby causing accelerated bone metabolism. This osseous hypermetabolism speeds up the phenomena of bone apposition–reabsorption and in turn accelerates

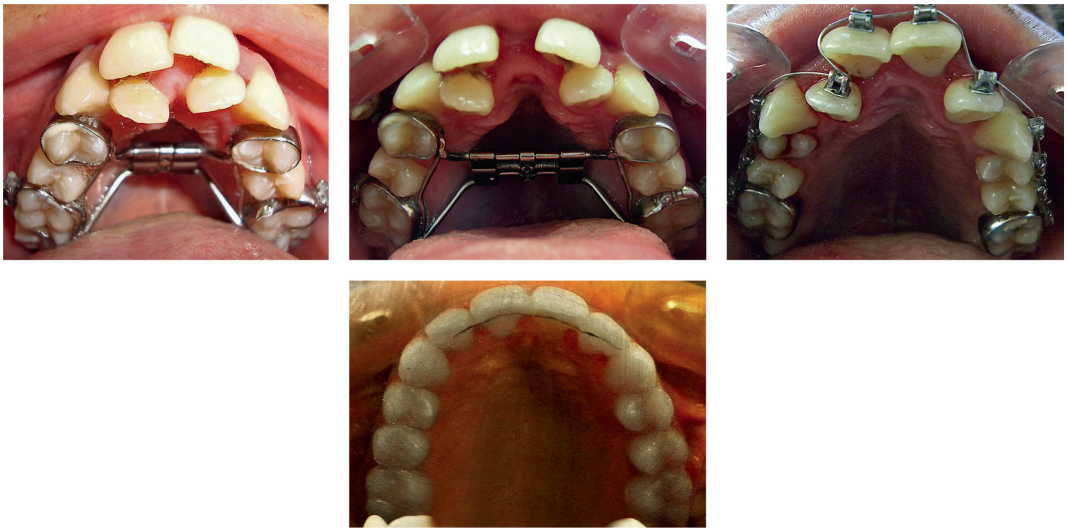

Figure 12: Rapid intermaxillary disjunction

orthodontic dental recovery. It is readily accompanied by an increase in preradicular bone mass. There is a therapeutic window of 2–3 months following surgery, where the benefit in terms of time and quality can be appreciated before seeking regular kinetic orthodontic treatment.

Corticotomies are increasingly being attached to procedures such as the disinclusion of included teeth or surgical maxillary expansions.

• Maxillary Expansion (fig. 12)

Orthopedic surgically assisted intermaxillary disjunction[2,14,16] has considerably developed in recent years due to many reasons:

– The recognition of the importance of the transversal dimension for achieving stable orthodontic and orthodontic–surgical results.
– The awareness of the importance and functional effect of maxillary expansion, for both respiration (with a considerable augmentation of the nasal flow) as well as the tongue (augmentation of the place available for the tongue and facilitation of lingual rehabilitation).
– To facilitate decompensation with more margin for linguoversion of the incisors and also the possibility to recreate some spaces in case of dental ageneses.
– The simplification of protocols making it possible to perform surgery with the disjunctor already sealed in place.
– The possibility for a significant increase in size, if needed, by two successive disjunctors.
– The possibility, with the aid of bone-supported trans-mucous disjunctors, to propose maxillary disjunction in situations where

Figure 13: Mandibular distraction.

dental support is compromised (temporary teeth with delayed eruption of definitive teeth, increasingly frequent edentulism in adults).

– In some cases, maxillary expansion can permit the correction of mandibular decentering or at least offer the possibility of some form of mandibular repositioning, which is sometimes beneficial in case of muscular tensions or postural impairments.

• Mandibular Expansion[12] (fig. 13)

This procedure is proposed more frequently, mostly since the arrival of dental-supported disjunctors and makes the expansion simpler and less invasive; the procedure can conducted in only one step (no longer necessary to place the disjunctor on bone support). Its contribution is particularly appreciated in case of

Figure 14: Impaction genioplasty.

obstructive sleep apnea syndrome and lingual dysfunction due to lack of space and sometimes as an alternative to therapeutic extraction.

Impaction genioplasty[35] (fig. 14)

This procedure can generally be offered from 12 years of age (eruption of canine teeth) to facilitate labial occlusion in the resting position and consequently improve nasal respiration.

Main Surgery

The recent major development in orthodontic surgery consists of a considerable improvement in surgical follow-up and preoperative risk reduction. There are different ways to explain this:

– Progress made with anesthesia and pain management with better-adapted protocols reducing the risk of postoperative edema and bleeding

– Better training for paramedical personnel and increased establishment of proper centers where patients are cared for in a holistic and multidisciplinary way (kinesiologist, psychologist, dietician, etc.)

– Improvement in the quality of information given to the patient, with more didactic digital support
– bypassing difficult blockages with elastic guidance and early orthodontic recovery.
– Reducing the amount of time spent hospitalized with more emphasis placed on patient participation, in terms of hygiene, postoperative care, or maxillofacial rehabilitation.
– Better preparation for intervention with 3D detection of dental nerve structures and even surgical simulation (this method is currently being optimized).

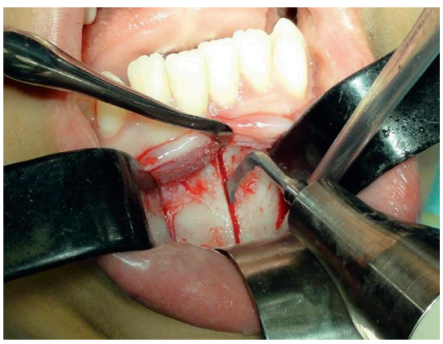

Figure 15: Piezosurgery

– Widespread use of piezosurgery[6,28] (fig. 15).

This technique is less traumatizing for the soft tissue than traditional mechanical instruments (drill, oscillating saw, etc.). This allows greater control and less preoperative risk for some procedures (liberation of the descending palatal pedicles in posterior impactions, pterygomaxillary disjunction, creating segmentations of expansions and or maxillary/mandibular contractions).

– During maxillary surgery, the surgeon anticipates the consequences and modifications linked to certain surgical procedures (strong advancement, strong impaction, etc.) Therefore, a septoplasty is performed at the same time as LeFort 1 to attenuate a nasal deviation (fig. 16).

Surgical completion (finishing touches)

The patient is informed from the beginning of the process that it is sometimes necessary to perform a certain

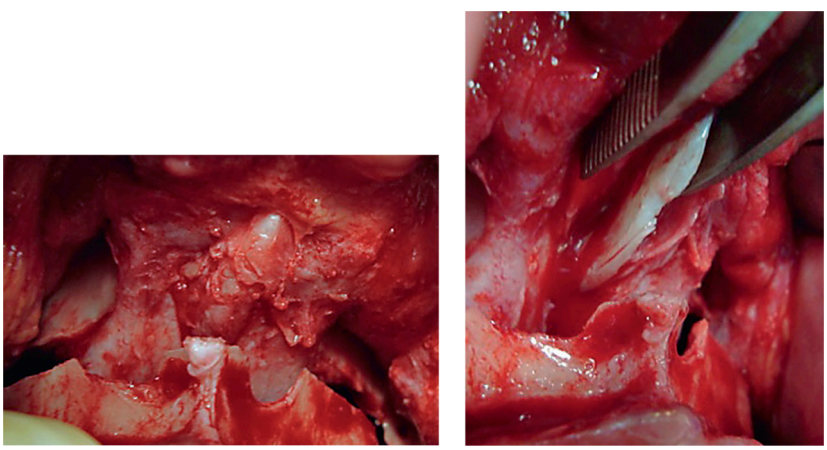

Figure 16: Deptoplasty concomitant to Lefort I.

Figure 17: Septorhinoplasty

number of complementary procedures to perfect the result. While these surgeries are necessary from a functional point of view, it is the job of the practitioner to explain the need for the procedure to achieve the best result and reduce the risk of relapse. These surgical procedures should not be considered a chance to "retry" **a missed or botched procedure but** should be an integral part to the entire process. On the other hand, if the patient was not informed from the beginning, they may think of it as a new "surgery" and possibly have a negative reaction or refuse to undergo it completely.

When these complementary procedures are motivated by morpho-esthetic reasons, the patient's request assumes new importance and the practitioner plays the role of an advisor. At times, the practitioner may have to resist the urge to correct an esthetic flaw that does not affect the patient, but sometimes the practitioner must temper the "exaggerated" request of the patient. In terms of applying the finishing touches, the most important thing is to provide pertinent information.

- **Ablation of osteosynthesis material**

The osteosynthesis material used during the intervention is generally titanium, which is biocompatible; therefore, its removal is not obligatory. However, many practitioners propose it to patients for various reasons:

- Ablation remains a light and simple gesture when it is conducted close to the intervention (within the 2 years that follow), whereas it is clearly more problematic later.
- Many patients are disturbed by the removal of the material, more often on a sentimental rather than a physically visible level, and it may result in psychological discomfort.
- For some patients, the plates cause the visible soft tissue to thicken and/or change texture.
- It is often an opportunity to perform surgical touch-ups concomitant to other procedures.

- Nasal corrections[8,23] (fig. 17)

Figure 18: Traditional genioplasty

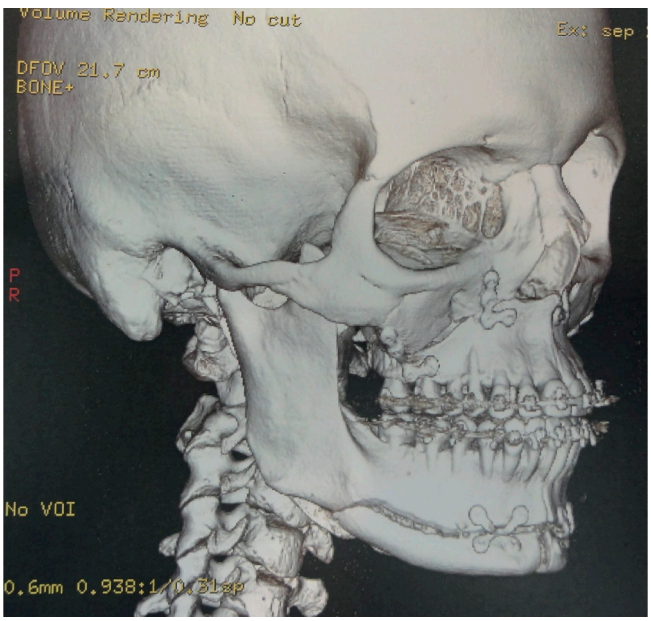

Figure 19: "Chin wing" genioplasty

Some nasal corrections are necessary for functional or esthetic reasons. Nasal permeability accompanying nasal respiration is an important factor for the stability of the result and notably for combating buccal respiration, which keeps the tongue misaligned when in the resting position and or during deglutition. Thus, septoplasty or septorhinoplasty may be necessary. From an esthetic point of view, correction may be required if modifications cause a maxillary gesture (particularly a strong advancement or an important impaction).

- Genioplasty[35] (fig. 18)

  The surgical procedures that can

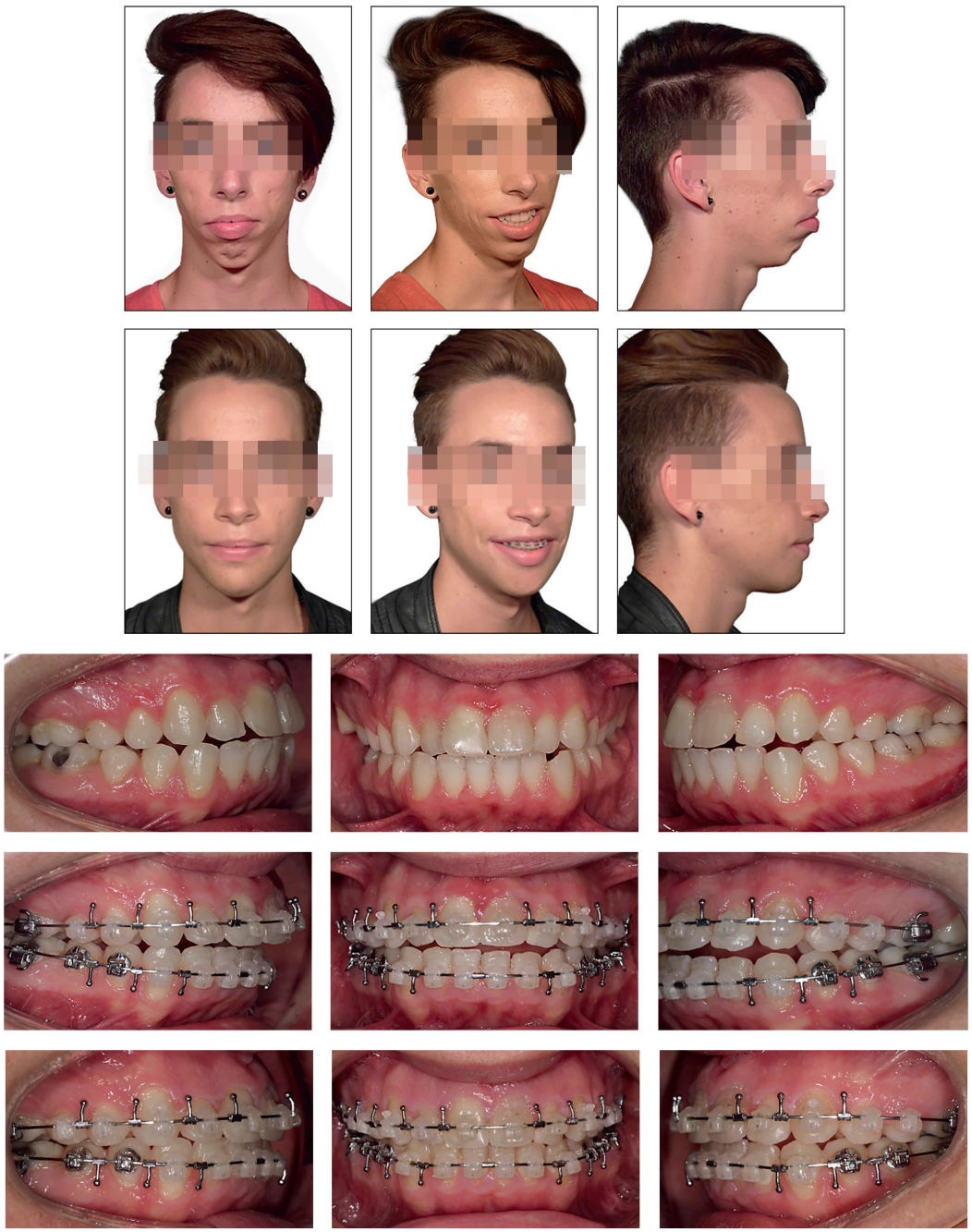

Figure 20: Benoit, aged 20

affect the chin are numerous and frequently necessary. From a functional perspective, it is necessary to facilitate labial occlusion at rest, allowing for better lingual positioning, thus reducing the risk of relapse. The precise parameters of size and direction of movement to the chin require the

practitioner to study the radiological images and soft tissue closely because sometimes, a discrete labial inocclusion does not accompany lingual interposition because of soft tissue compensation.

From an esthetic point of view, recentering, horizontalization, complementary advancement, or even attenuation of the chin projection can be deemed necessary as per the patient's request.

The recent development in this domain is Albio Triaca's[37] "chin wing," and it consists of genioplasty expanded to the mandibular angle. A variant of this stops a bit shorter and its method is between chin wing and conventional genioplasty. It is an extremely efficient gesture both functionally and esthetically as it impacts the soft tissue more (fig. 19).

• Contour surgery

The focus is correcting not only the mandibular angles but also the persistent asymmetries of the mandible and maxilla. This surgery is indicated in the cases of simple procedures, such as bone regularizations and also in the cases of more complicated procedures, such as maxillary or mandibular bone graft appositions. Further, there is space for other procedures, particularly when flaws that persist concern the soft tissue.

CONCLUSION

The treatment strategy for orthodontic–surgical procedures has evolved technically, with the expansion and modernization of the therapeutic orthodontic and surgical arsenal, and particularly from a conceptual viewpoint, where the treatment and framing of functional parameters (respiration, tongue, mastication, and posture) are concerned. The result presents a clear improvement in the quality and stability of results and at the same time simplifies the follow-up and progression phases of this type of treatment[2,7,24] (fig. 20).

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Conflict of Interest

The authors declare that they do not have any conflict of interest.

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