Abstract

Orthognathic surgery is a surgical procedure largely practiced throughout the world for the correction of various maxillofacial deformities. The procedure for correcting a particular deformity will be done after proper evaluation, which includes cephalometric, dental model analysis and photographs. The patient undergoes pre-surgical orthodontic correction for dental compensation, after which surgery is planned. During the last few decades, the profession has witnessed intense interest for the treatment of facial deformities, being widely practiced throughout the world. Orthognathic surgery has become an acceptable treatment plan for patients with various maxillofacial deformities, giving pleasing results. The present study reports the successful treatment method of Class II division 1 malocclusion through orthognathic surgery.

**Keywords:** facial deformity, Lefort maxillary osteotomy, pre-surgical, post-surgical treatments.

INTRODUCTION

For patients whose orthodontic problems are so severe that neither growth modification nor camouflage offers a solution, surgical realignment of jaws or repositioning of dentoalveolar segments is the only possible treatment. Surgery is the substitute for orthodontics in these patients. Dramatic progress in recent years has made possible combined treatments to correct many severe problems simply untreatable only a few years ago. [1,2,6] Once the treatment for a particular patient has been planned, the following sequence of procedures needs to be followed:

1. Pre-orthodontic preparation – Control of pathological problems;
2. Pre-surgical orthodontics;
3. Final surgical preparations;
4. Surgery and post-operative care;
5. Post-surgical orthodontics;
6. Retention.

PRE-ORTHODONTIC PREPARATION – CONTROL OF PATHOLOGICAL PROBLEMS [2,3,5,6]

Since the majority of orthognathic surgical patients are adults, the orthodontist usually has to solve the problems not routinely encountered in adolescents, which usually include:

a) Chronic systemic diseases;

b) Pregnancy;

c) Prolonged use of drugs;

d) Dental problems.

SURGICAL AND ORTHODONTIC TREATMENT

Combined surgical and orthodontic treatment requires the integration of pre-surgical orthodontics, surgery and post-surgical orthodontics.

PRE-SURGICAL ORTHODONTICS [2-4]

Pre-surgical orthodontics is mainly aimed at removing the dental compensations of the malocclusion.

Goals:

1. To align and level teeth without concern for dental occlusion
2. To establish proper antero-posterior and vertical position of incisors;
3. To achieve arch compatibility.
A general guideline, every patient will need a more or less constant period of post-surgical orthodontics (between 4-6 months). Pre-surgical preparation time varies.

If the patient is not properly prepared:
1. Surgery cannot be carried out effectively;
2. Quality of the result is diminished;
3. Post-surgical orthodontic treatment time increases.

However, a certain amount of pre-surgical preparation can be a waste of time, as the duration of post-surgical orthodontics will not be reduced.

Procedures recommended and necessary before surgery:
1. Alignment;
2. Levelling – by intrusion;
3. Arch compatibility.

Procedures that can be done before and/or after surgery:
1. Post-crossbite correction;
2. Levelling by extrusion.

Procedures necessary after surgery:
1. Settling and levelling by extrusion;
2. Root paralleling at osteotomy sites;
3. Detailed tooth positioning.

FINAL SURGICAL PLANNING AND PREPARATION

When the patient is ready for surgery, the following set of records are taken, usually about 2 weeks before surgery, after the final rectangular wires had been in place for 3 weeks or more so, that they are passive:
1. OPG (orthopantomogram);
2. Lateral cephalogram;
3. Casts;
4. Intra- and extra-oral photos;
5. Postero-anterior cephalogram – if facial asymmetry is observed;
6. IOPAs (intraoral periapical radiographs) and occlusal view, if needed;
7. Face bow transfer onto an articulator, if needed.

OPG is used to verify that root positions will not interfere in osteotomy cuts. The roots should be slightly divergent or parallel, but not converging. The cephalogram provides cephalometric predictions, for guiding the model surgery, while casts are to be used for model surgery itself.

SPLINT REQUIREMENTS

The split should fit the teeth accurately, and no resin distortion should occur.
1. It should have the minimum thickness required for adequate strength, not exceeding 2 mm.
2. The excess of acrylic material should be trimmed off the buccal aspect, to allow for proper visual verification during surgery and for oral hygiene maintenance.
3. It should allow IMF (intermaxillary fixation) ease.
4. If rigid internal fixation is to be used, the patient will have to function into the splint soon after the surgery. It must be trimmed so that only the occlusal indentations of the teeth are present in it, thus permitting lateral movements, and yet providing a stable occlusal relationship.

POST-OPERATIVE EVENTS

1. The patient usually needs to be hospitalized for 2-3 days after single jaw surgeries, and about 4-5 days for double jaw surgeries.
2. Post-surgical radiographs are taken the day after surgery, or soon after it.
3. Patients usually restrict to limited activity for at least 2 weeks, while some of them start working even after a week.
4. Facial oedema are solved within 2-3 weeks, the final oedema disappearing when the patient resumes function – which is faster after rigid internal fixation.
5. Mastication can be resumed after 6-8 weeks.
6. Full bone remodelling takes up to 6 months.
POST-OP CARE

1. Patient are advised to be on soft diet for a week (milk, potatoes, rice, eggs).
2. After 2 weeks, progress to foods that require more chewing and slow progress to normal diet follows. By 6-8 weeks after surgery, normal diet should be resumed.
3. Progress can be hastened by physiotherapy, beginning as soon as the initial intra capsular joint oedema has resolved, namely after about 1 week.
4. Along the 1st week after surgery, open and close mouth gently within comfortable limits.
5. Over the next 2 weeks, 3 sessions (10-15 min) of opening and closing and of lateral movements are recommended.
6. Along the 3rd-8th weeks, the range of motion is increased, reaching normality within 8 weeks.
7. The orthodontist should see the patient in the 1st week, review the occlusal status and check the status of the orthodontic appliance.
8. Post-surgical orthodontics can start when adequate bone healing was attained, and the patient has adequate mouth opening. Rebonding and re-banding of loose attachments can be now done.
9. With rigid internal fixation and jaw exercises soon after surgery, post-surgical orthodontics can usually resume within 2-3 weeks. With wire fixation and IMF, about 3-4 weeks should be necessary after IMF’s releasing.
10. In either case, once the patient starts functioning, the splint must be ligated to one of the arches to guide the occlusion; light elastics may be also used to guide the jaw function.

POST-SURGICAL ORTHODONTICS

If any doubt occurs as to the healing of the surgical site, it is better to delay post-surgical orthodontics for a few weeks, rather than to deal with complications later. The first step is to remove both the splint and the stabilizing arch wires. Any repairs to the appliance can be then made and, later on, the working orthodontic wires can be placed. The splint and stabilizing wires should be concomitantly removed. The purpose of the stabilizing archwire is to prevent teeth movement. [5-8]

The working archwires are usually light wires – 0.016” steel, flexible enough to provide the as required adequate extrusion of teeth. If a good torque control of the maxillary incisors is needed, it may be better to use a flexible rectangular wire, such as braided wires or NiTi. If teeth movement in the lower arch is needed, the maxillary stabilizing wires can be left and a flexible wire can be placed only in the mandible. Finally, the patient should be given light vertical elastics, both to the posterior and anterior segments, if an open bite tendency appears. Box (green or yellow) elastics are preferred, as patients find them easier to put, as compared to smaller elastics. The elastics should be full time worn, during eating included.

The elastics serve 2 purposes, namely:

1. They help teeth settling, bringing them into a good, solid occlusion.
2. Override patient’s proprioceptive drive towards positioning of the mandible in maximum intercuspation. As long as the elastics are worn, no tendency to shift the mandible away from the CR will be manifested.

The elastics can be run in Class II or Class III direction, depending on the requirements of occlusion. Cross elastics can be also used.

By the second post-surgical appointment, [6-9] considerable settling would have occurred as, in the absence of any occlusal interferences to the teeth, they extrude quite easily.

If the occlusion was well-settled, the elastics can be worn only during the night.

The usual sequence of elastic wearing is:

1. Full-time, including during eating in the first month.
2. Full-time, except during eating in the next month.
3. Only at night in the 3rd month.

Vertical step bends may be placed in the archwire to allow the rest of the teeth to come into occlusion. At this time, elastics may or may not be placed.
If heavier intermaxillary elastics are preferred, heavier rectangular archwires should be placed. Otherwise, light wires can be used until the occlusion has been properly settled.

In patients having suffered transverse skeletal expansion, the corrections have the tendency to relapse for approx. 6 months. Hence, along with the finishing wires, a labial overlay wire – 36 or 40 ml – should be placed from one headgear tube to the other, to help transverse stabilization.

The minimum time of pre-surgical orthodontics is usually 3 months. A time longer than 6 months means that some complications have occurred during surgery.

The goals of post-surgical orthodontics can be summed up as follows:

1. Establishment of final occlusion, including final alignment, interdigitation, torque, artistic positioning.
2. Establishment of correct root parallelism, especially at the osteotomy sites, where roots of adjacent teeth may have remained divergent.

RETENTION

Retention considerations are not very different from routine orthodontics, except for stabilization in transverse plane. Retainers should be full time worn, except during eating for 3-4 months, the time required for the periodontal ligament (PDL) fibers to reorganize. In case of periodontally-compromised patients, splinting of the teeth together is preferred. [8-10]

CASE REPORT – LONG FACE PROBLEMS

Most common cause: inferior rotation of the posterior maxilla, and hence wedging of the mandible down and back, and excessive face height, especially in the lower 1/3. As the mandible moves back, reduction in chin prominence is noticed, and hence AP problems appear. Usually, the lower incisors are upright and crowded. There is a skeletal open bite tendency, however, if incisors supra-erupt sufficiently, a normal bite or even a deep bite may appear.

Lip incompetency. Gummy smile usually seen, sometimes minimal.
Narrow maxilla and tendency for posterior cross-bites.

Surgical Considerations

3 options for correction are available:

1. Impacting to maxilla, or at least to the posterior maxilla, reduces the gummy smile, causing self-rotation of the mandible and correction of the vertical problem.
2. Rotating the mandible upwards and forwards after BSSO.
3. Chin procedures (inferior border osteotomy), usually used as adjuncts.

The maxillary procedure is the most preferred one, because the problem is usually in the maxilla, which it corrects. The procedure is also very stable. Mandibular rotation, quite unstable, causes upper stretching of the soft tissues. The maxillary procedures can also use arch segmentation if expansion or differential movement of the anterior and posterior segments is required.

Pre-surgical Orthodontics

Basically, the orthodontist should know whether:

1. Is the maxilla going to be kept in 1 piece, or is it going to be sectioned? If so, in how many sections will be, and where?
2. Is the chin position going to be changed, or is the proper lip–chin balance going to be achieved orthodontically?

Goals:
Alignment – Levelling – Arch compatibility
If the maxilla is going to be segmented, aligning is to be done only within the segments.
The roots of the teeth next to the osteotomy site should be slightly divergent or parallel, but not convergent.
Levelling – In case of a mild COS, it can be pre-surgically levelled by intrusion.
Sometimes, COS is so severe that a clear-cut step can be seen between the anterior and posterior teeth. In such cases, it is better to level the COS surgically.
Expansion – if minimal expansion is needed, it can be done orthodontically. Otherwise, surgical expansion is recommended. It is advisable to do the expansion during the same surgery, and not as a separate surgically-assisted RME.

If surgical expansion is to be done, the arch should not be expanded orthodontically. The torque of the molars should be corrected, which may actually involve arch contraction.

Remember – Both orthodontic and surgical expansions have a relapse tendency. If both are combined, the relapse tendency is augmented.

If the levels of the segments are different, a stabilizing wire with steps can be used just before the surgery or, even better, separate segments of 21×25 wires should be used within each segment.

Pre-surgical planning

Two aspects need to be known, namely:

1. How far up should the maxilla be moved?
2. What should be done if any overjet remaining after the maxilla is impacted?

Moving the maxilla too far up can be problematic.

- Wrinkles form on the cheek as bony support is lost.
- Incisors can be moved too far up.
- Widening of the alar base of the nose may occur.

All these give the individual an aged appearance. Usually, more maxillary impaction is tolerated by younger individuals. A too high impaction can suddenly make them look much older.

Frequently, if a small overjet is present after impaction of the maxilla, there is a temptation to position the maxilla slightly back, to avoid another jaw surgery. This will reduce support to the lips, and worsen the aesthetics, if the maxilla was not initially prognathic. Quite often, the maxilla may need to be advanced to get a good lip support.

Sometimes, a simple inferior border osteotomy which will position the chin up and forward will be sufficient for correcting the increased face height (after maximum impaction had been done). This is stable and predictable.

During surgery, care must be taken to relieve the maxilla completely, a most difficult thing to attain in the posterior region, where the posterior maxilla, tuberosity and dense palatine bone must be removed. When the maxilla has an upper position, no bony interferences should appear, or else, the position will not be correct. A 1-2 mm discrepancy can be corrected by elastics, yet larger ones might need re-surgery.

Post-surgical Orthodontics

If the patient has had a maxillary anterior segment osteotomy, torque control of incisors is needed. Hence, flexible rectangular wires, like 21×25 NiTi or Braided Steel regular 16 mil wires, can be used in the lower arch. If surgical expansion has been done, it should be held using a heavy (19 gauge) labial overlay wire for at least 6 months.

Case Summary

A 19 year-old male with permanent dentition presented with a complaint of “spacing and forwardly placed front teeth”, as well as of poor appearance. Clinical examination revealed a long facial pattern with severe interlabial gap at rest, and a convex profile (Fig. 1). The patient had a skeletal Class II pattern with 11 mm of overjet, increased overbite, and an excessively lower curve of Spee. The patient had a full-cusp Class II malocclusion on the right and left sides. The lateral cephalogram showed a skeletal Class II discrepancy with mandibular retrognathism, skeletal deep bite, increased lower anterior facial height, proclined upper and lower incisors, an excessively lower curve of Spee, and protrusive maxillary central incisors contributing to reversion of the lower lip (Fig. 2).

Treatment Planning

The main aesthetic objectives of the treatment were to reduce patient’s facial convexity, while decreasing the lower anterior facial height.
The occlusal goals were to maintain a Class II occlusion, to level the lower curve of Spee through post-surgical eruption of the buccal segments, and obtain a normal overbite and overjet. The primary purpose of the orthodontic treatment was to attain a Class I canine and full cusp Class II molar relationship, while maximizing the aesthetic impact of the surgical movements. Maxillary impaction surgery and genioplasty were planned, as generally considered stable and predictable (Fig. 3).

Treatment Progress

Both arches were fully banded and bonded with .022” preadjusted appliances. Archwire sizes were gradually increased until .021” × .025” stainless steel surgical wires, placed in both arches, for maintaining the exaggerated lower curve of Spee (Fig. 4). The wires were allowed to express the bracket prescription, a month before impressions for the surgical stent were taken.

The pre-surgical setup was then constructed, and a stable tripod occlusion was verified on the casts. A full-coverage maxillary surgical stent was fabricated from a cold-cure acrylic material, extending bilaterally from the first molar to first molar in occlusion (Fig. 5).
Surgery was performed without complications, and the correction was maintained with rigid internal fixation. Good occlusion was achieved post-surgically (Figs. 6-7). After 6 months of post-surgical detailing and finishing, consisting mostly of correcting the 3rd-order inclinations of the lower second molars, the appliances were deboned (Fig. 8). Maxillary wrap-around and mandibular fixed retainer were given for retention.
DISCUSSION

In the traditional combined orthodontic and surgical treatment of dentofacial anomalies, pre-surgical orthodontics is aimed at relieving dental crowding and decompensation, at providing stable occlusion, a proper position for the teeth and arch coordination after the operation. Pre-surgical decompensation is the longest step of the total treatment, roughly around 6 months to 2 years, yet varying among patients and orthodontists. During this period, patients may experience deterioration of both facial profile and function. In skeletal class II cases, the lower incisors are usually upright, while the maxillary incisors are commonly flared out. One of the goals of pre-surgical orthodontics is to position incisors in a proper angulation to the jaw bone, so that the surgeon can set back the jaw bones to their maximum. Sometimes, extraction is required for retraction of the upper anterior teeth and relief of the gumminess of smile. This also increases the time needed for pre-surgical preparation. The position of the anterior teeth is important, being related to the amount of maxillary impaction. A concomitant genioplasty to adjust lower face proportions might also help to achieve this goal. The patient and his family were quite surprised and happy with the dramatic facial profile improvement immediately after surgery. A symmetrical, harmonious relationship of the facial soft tissue and a pleasant profile were obtained after the treatment. Lip competence was also achieved. Significant improvements in the vertical facial proportions and occlusal function were noted. Occlusal records revealed well-interdigitated and aligned dentition. A Class II occlusion on both sides and a normal overjet and overbite were established. The panoramic radiograph revealed good root parallelism. Lateral cephalometric films showed proper labio-lingual angulation of the upper and lower incisors.

References


