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Review Article

Orthodontics for orthognathic surgery: A review

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ABSTRACT

Malposition teeth or obvious jaw deformities; are conditions that require orthodontics for orthodontic correction but a combined approach with surgery. Severe deformities that require a combination of orthodontics and surgery for correction are called dentofacial deformities. Surgery to straighten the jaws or relocate dentoalveolar segments is the sole option for patients whose orthodontic problems are so severe that neither growth modification nor concealment can help. Surgical treatment is not a substitute for orthodontics in these patients. Coordinated with orthodontics, other dental treatments and surgery are necessary, to achieve good overall results. Significant advancements in the past several years have allowed for the correction of many serious issues that were untreatable just a few years ago with combination treatment.

1. Introduction

Surgical orthodontics is the art and science of diagnosis treatment planning and execution of treatment by combining orthodontics and oral and maxillofacial surgery to correct musculoskeletal, dento-osseous, and soft tissue deformity of the jaws and associated structures. *Hullihen in 1849* first coined the term orthognathic surgery. Orthognathic surgery is a unique endeavor in facial surgery, which is indicated in patients who have severe skeletal malformation of the jaws and in patients whose growth has been completed and growth modifications cannot be done. Tremendous advances in the area of orthognathic surgery have occurred over the past 25 years. Orthognathic surgery has created new and exciting opportunities to correct severe problems that were untreated only a few years ago.

Envelope of discrepancy indicates the limits vary both by the tooth movement that would be needed and by the patient's age as quoted by William R. Proffit,[1] (1992)

Orthodontically, teeth can be moved in some directions, but there are limitations for the teeth movements. But the teeth movements can be changed little if any with age, where the growth modification is possible. In that case, active growth should be present.

There are three possibilities for treatment;

1. Teeth movement by orthodontic treatment.
2. Teeth movement by orthodontic treatment combined with growth modifications.
3. By orthognathic surgery.

The amount of tooth movement attained by the three potential treatment methods in three dimensions of space—three envelopes and the X and Y axes—is shown by this envelope of discrepancy (Figure 1 and Figure 2).

1. Inner envelope- the amount of change produced by orthodontic tooth movement.

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2. Middle envelope- orthodontic tooth movement combined with growth modification.
3. Outer envelope- orthognathic surgery.[1,2]

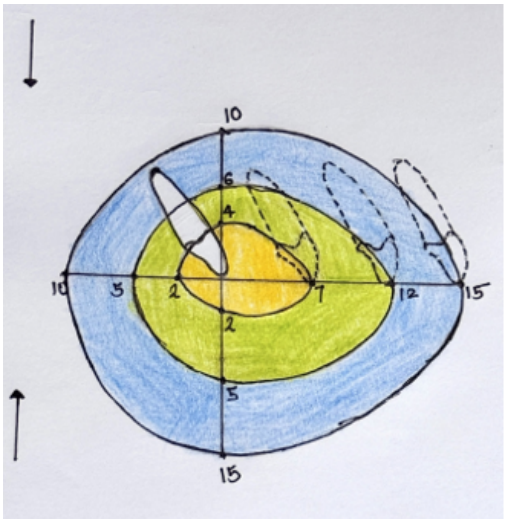

Figure 1: Maxilla

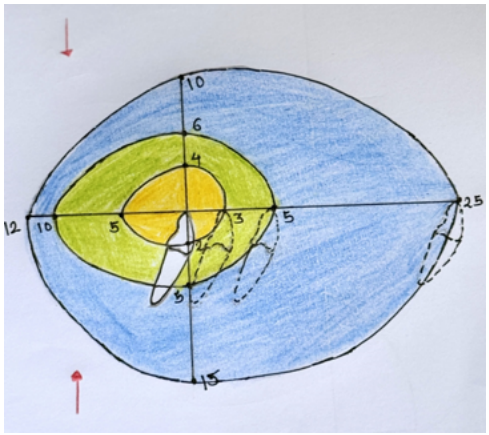

Figure 2: Mandible

2. Discussion

Orthognathic surgery compromises the occlusion while repositioning the basal bone. To attain optimal interarch relationship and aesthetics, orthodontics treatment must be performed. Orthodontic treatment can be divided in two phase, preorthodontic and postorthodontic treatment phase. Presurgically decompensation keep the teeth in the mandible and maxilla basal bone in an ideal position for balance and harmony following surgery. Following are the various treatment objectives to be considered for orthognathic surgery and various types of surgeries for different skeletal deformities.

3. Treatment Objectives Of Orthognathic Surgery

The goals of orthodontic treatment have been proposed in various terms throughout the development of the specialty.

Larry Wolford and R. Fields[3] Basic therapeutic goals for orthognathic surgery are.

1. Function - Normal mastication, speech, ocular function, respiratory function.
2. Aesthetics - Establishment of facial harmony and balance.
3. Stability - Prevention of short- and long-term relapse.
4. Minimizing treatment time - Provision of efficient and effective treatment.[1]

3.1. Collection of database

3.1.1. Demographic data

1. History
2. Chief complaint
3. Socio-psychological evaluation
4. Family history
5. Medical history
6. Dental History

3.1.2. Systematic patient evaluation

1. Aesthetic facial evaluation
2. Functional Facial Evaluation
3. Intra-oral examination
4. Model analysis

3.1.3. Radiographic examination

1. Lateral cephalogram
2. Ortho-pantomogram

E. video imaging[4]

4. Diagnosis and Treatment Planning

Diagnosis and treatment plan plays an important role in treatment outcome. Diagnosis is identifying of the accurate problem and using of diagnostic aids to solve the problem.

The diagnosis and treatment planning and execution of treatment comprises four phases:

1. Phase I- Includes assembling the database, synthesizing the problem list, diagnosis, and team conference
2. Phase II- Include developing inter-disciplinary problem list which is discussed with the team of doctors and with the patients to solve the problem and planning the treatment.
3. Phase III- Includes the preparatory phase which includes restorative, endodontic, periodontics, the definitive orthodontic-surgical treatment and continuous team monitoring, re-evaluation, interaction, and modification of the therapy.

4. Phase IV- It is the maintenance phase

5. Pre-Surgical Orthodontics

5.1. Intra-rrch objectives

In the initial stages of treatment, orthognathic and conventional orthodontic mechanics have some similar objectives: -

1. Position the teeth ideally relative to their apical bases through the establishment of correct torque,
2. Proper elimination of rotations,
3. Flatness of the plane of occlusion and
4. Eliminating tooth-arch length discrepancies.

Intra-arch mechanics in orthognathic cases should be designed to achieve the ultimately desired post-surgical interdigitation and allow for the establishment of class I canine and molar relationship after surgical treatment.[4]

5.2. Sequencing of orthodontic mechanics prior to surgery

1. Orthognathic surgery should not be performed until the adolescent growth spurt is completed and mandibular setback for mandibular prognathism should be deferred until growth is completed.
2. Surgical correction of maxillary and mandibular deficiency and correction of vertical maxillary excess can be carried out with a good prognosis in most patients who are in their mid-teens because late growth rarely causes problems.
3. Nevertheless, post-surgical growth is a potential problem and for stability, “later is better than sooner in the timing of surgery”.

However, the initiation of orthodontic treatment often helps patients tolerate dentofacial deformity during their teen years even if surgery is some time in the future. The orthodontic appliance serves as a visible symbol that the dentofacial correction is being treated.

5.3. Why edgewise is a chosen appliance for surgical orthodontics

Fixed appliance used to stabilize the teeth and the bone, at the time of surgery and during healing.

Therefore, the appliance system must permit the use of rectangular wire to achieve adequate strength and stability. We can therefore use variations of the pre-adjusted edgewise appliance and its combination with Begg. Also, the appliance removal precludes the need for orthodontic finishing.

6. Extraction Pattern for Decompensation

Prior to treatment, dental compensation is frequently seen in skeletal class II instances. The dentoalveolar apparatus frequently proclines lower incisors in an effort to conform to the underlying class II skeletal structure. If proclined lower extremity surgery was to continue, incisor, the amount of mandibular advancement that is allowed would be limited. By the overjet, which can be less than whats needed for an intented and a suitable alteration to one’s profile. In skeletal class II instances, frequently. The removal of lower bicuspid can retract and upright the decrease the anterior teeth and provide more skeletal movement, or the bicuspid of lower first and upper second can be taken out. And reverse for skeletal class III. Extraction pattern for various skeletal decompensation is given in Table 1.[1]

Table 1: Extraction pattern for orthognathic surgery

Skeletal deficiency	Extraction pattern
Class II	Upper first premolar and lower second premolar/ lower first premolar
Class II + Mandibular deficiency	Upper first premolar extraction
Class II + Severe mandibular deficiency	Extraction of lower premolar Lower body osteotomy
Class III	Upper first premolar and Lower second premolar. Correction of axial inclination and increase overjet- upper first premolar. Space requirement in lower arch- lower second premolar extraction.[1]

6.1. Surgical decision

6.1.1. Maxillary setback

The procedure is usually indicated in maxillary protrusion, the features associated are;

1. Convex face
2. SNA angle increased
3. Distance of A to the facial plane (Na-Po increased
4. The horizontal dimension of the maxilla increased
5. Angulation of upper incisor increased
6. Visibility of upper teeth – more with a gummy smile
7. Nose – lip angulation – decreased
8. Maxillary depth angle – increased
9. Ratio of maxillary and mandibular length – maxillary length – increased[4,5]

6.1.2. Superior repositioning of maxilla

The procedure is indicated in the vertical dimension of the lower third of the face is increased along with increased exposure to anterior teeth and interlabial distance, features

associated with this are;

1. Distance from subnasale to menton decreased
2. Chin prominence – increased
3. Alar bases – widened
4. Facial convexity increased[4,6]

6.1.3. Sub-apical osteotomy of the anterior mandible

The procedure is usually indicated in anteroposteriorly deficiency, features associated are;

1. Anterior crossbite with no lip chin deformity
2. Lower lip pronounced
3. Closure of open bite
4. In bimaxillary protrusion
5. In combination with mandibular advancement[4,7]

6.2. Maxillary advancement

The procedure is usually indicated in maxillary deficiency, features are;

1. Concave face due to deficiency of maxilla
2. May be associated with class III malocclusion with crossbite
3. Accentuated nose lip angulation.[4,8]

6.3. Mandibular setback

The procedure is usually indicated in mandibular excess, features are;

1. Chin prominence
2. Overexposure of lower lip
3. Lack of lip-chin definition
4. Increased lower third height
5. Increased mandibular plane angle
6. Increased facial axis angle/depth angle
7. Horizontal distance from point A to the nasion – pogonion line is increased
8. Class III malocclusion with or without cross-bite[4,9]

The mandibular setback has been done at the level of ramus–sagittal split osteotomy, sub sigmoid vertical osteotomy, at the body or the level of premolar.

6.4. Mandibular advancement

The procedure is usually indicated in mandibular retrognathism, features are;

1. Facial axis angle – reduced
2. Facial depth angle – reduced
3. The length of mandible is less in relation to maxilla
4. Vertical dimension of lower third face is reduced.[4,10]

6.5. Genioplasty

Done when the deformity is in the chin. Chin can be repositioned in all three dimensions. Soft tissue movement is 60% - 70% with bony movement.[4,11]

7. Model Surgery

Model surgery simulates the actual surgery, in the dental arch models of the patient. It gives a three-dimensional understanding of the post-operative relationship of the jaws.

The basic reason for performing the model surgery is,

1. To determine if the indicated surgical procedure will produce an occlusion that can be simply and safely perfected by subsequent orthodontic treatment.
2. To get a definite idea about the extent of bone/arch advancement or reduction required in the surgery.
3. To get a post-operative relationship of the jaws, dentition, and occlusion
4. To decide about the post-surgical orthodontic treatment
5. As a vehicle for the fabrication of splints for stabilization after surgery

There are two basic types of feasibility model surgery.

1. Whole arch
2. Segmental

Whole arch feasibility model surgery is done by hand articulating dental models into the best possible occlusion.

Segmental feasibility model surgery is done by sawing the upper lower or both dental models into the dento-osseous segments to be produced at surgery and re-assembling them into the best possible occlusion while using any simple hinge type articulator to help hold the model bases.[1,12,13]

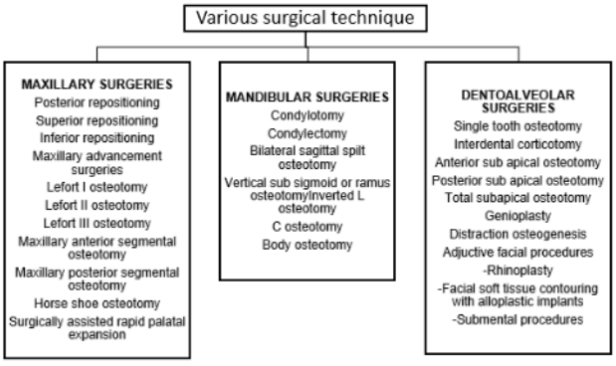

Figure 3: Various surgical technique

8. Post-Surgical Orthodontics and Retention

Orthodontic objectives following surgery are generally similar to those considered in finishing a conventional orthodontic case. The post-surgical treatment time needed to reach such an objective varies according to the type of patient, a minimum of 3-4 months is required for post-surgical treatment.

Wong B.W.[14] (1985) developed a method of splint construction in all three planes of space for maxilla, mandible, and bimaxillary procedures as it is simple to operate and saves the clinicians time. Okumura H. et al.[15] (1999) used CAD/CAM fabrication of occlusal splints for orthognathic surgery.

8.1. Post-surgical orthodontic consideration

8.1.1. Immediate post-surgical control

After the release of fixation, is the important time under the orthodontist's control. During this time orthodontists can produce rapid and drastic changes that will profoundly affect the final result about stability and function.

8.1.2. Appliance repair

All the arch wires are removed and the fixed appliance is checked for damage. Any bands or bonded attachments that have become loose, bent, or otherwise damaged are replaced.

8.1.3. Arch wires

After surgery, arch wires that were removed are placed back in the mouth unless either they were damaged that they require replacement.

After segmental surgery, the archwire selection must be considered. If the arch width was changed as part of surgery, a lingual arch should be placed. Expansion should be stabilized by a slightly expanded arch capable of exerting 3-4 O2 of pressure, constriction can be stabilized by a passive arch that has been heat-activated.

8.1.4. Objectives for labial arch wire

1. Rapid leveling of the teeth in adjacent segments
2. Re-approximation or maintenance of surgically produced contact between the teeth in adjacent segments
3. Provide attachment for use of interarch elastic traction

The simplest approach is to ligate the teeth adjacent to the osteotomy or ostectomy with a figure 8 tie and to place a continuous flexible wire. Flexible wire has a disadvantage, as they are not rigid enough to hold the segments or to maintain the arch shape during the leveling process. The most effective is a stainless-steel wire with an appropriate loop. Sectional wires can be used and continuous flexible wires can be placed over these (piggy back) to level the segments.

8.2. Force application

Immediate application of orthodontic force to the teeth will allow more rapid resolution of any remaining malocclusion. So, this is an opportunity wherein the adult patient's teeth move like those of an adolescent.

Patients are seen more frequently for the first month or 30 after release of fixation. Patient is seen on 3-4th day after surgery to check if he/she is having any problem. If all is well, second appointment in 1 week, then in 2nd week, and then routing for 4 weeks.

8.3. Finishing

It is the most important part of post-surgical orthodontics and is a deliberate attempt to achieve.

1. Compatibility between centric occlusion and centric relation
2. Canine protection
3. Incisal guidance
4. Root parallelism
5. Pleasing appearance

These goals are achieved carefully by archwire manipulation, intraoral elastics, and extraoral traction. After completing finishing the patient is placed in passive arch wire and if good stability is demonstrated in the absence of any mechanics, the appliance is removed. First, all bands except the most posterior are removed and 16 x 16 closing loop archwire is placed to close the remaining spaces.

8.4. Retention

For retention, conventional retention appliances are given or the appliance is placed as it is for a few months.[13]

9. Conclusion

With surgical procedures and the application of a combined surgical and orthodontic team approach to the correction of dentofacial deformities, the scope of orthognathic surgery has vastly increased.

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None.

10.1. Conflict of Interest

None.

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