REVIEW ARTICLE

A Countdown to Orthognathic Surgery

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ABSTRACT

For patients whose orthodontic problems are so severe that neither growth modification nor camouflage offers a solution, surgery to realign the jaws or reposition dentoalveolar segments is the only possible treatment. Surgery is not a substitute for orthodontics in these patients. Instead, it must be properly coordinated with orthodontics and other dental treatment to achieve good overall results.

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INTRODUCTION

Tremendous advances[1] in the area of orthognathic surgery have occurred over the past four decades. Rapid advances in surgical technology have made it possible to successfully treat patients for whom orthodontic camouflage was once the only method of treating a dentofacial deformity which often resulted in esthetically unacceptable and, quite often, unstable results. A person's ability to recognize a beautiful face[2] is innate, but translating this into defined treatment goals is problematic. Recognizing beauty is not practiced nor is it difficult. The perception of beauty is an individual preference with cultural bias.

HISTORY

Orthognathic surgery began a century ago with the treatment of mandibular prognathism[3] for almost 50 years skeletal class III patients were treated by mandibular body osteotomies with an external approach. Today, studies have shown that isolated mandibular setbacks are used in fewer than 10% of the patients, in favor of maxillary and double jaw surgery,[4] the introduction of the sagittal split ramus osteotomy by Trauner and Obwegeser[5] marked the beginning of the modern era in orthognathic surgery.

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Development of Orthodontic Surgery

Surgery for mandibular prognathism[6] began early in the twentieth century with occasional treatment that consisted of a body ostectomy, removing a molar or premolar tooth and an accompanying block of bone.

Edward Angle, commenting on a patient who had treatment of this type over 100 years ago, described how the result could have been improved if orthodontic appliances and occlusal splints had been used. Although there was gradual progress in techniques for setting back a prominent mandible throughout the first half of this century, the introduction of the sagittal split ramus osteotomy in 1957 marked the beginning of the modern era in orthognathic surgery.

Envelope of Discrepancy

We have called the theoretical boundaries of the potential range of tooth movement the envelope of discrepancy.[1]

The envelope can be thought of as an elastic three-dimensional, asymmetric closed container. Orthodontics alone rearranges the contents of the container; orthopedic functional treatment and surgical treatment change the shape of the container.

For any characteristic of malocclusion, four ranges of correction exist: (1) An amount that can be accomplished by orthodontic tooth movement alone; (2) a larger amount that can be accomplished by orthodontic tooth movement aided by absolute anchorage (bone anchors); (3) an additional amount that can be achieved by functional or orthopedic treatment to modify growth; and (4) a still larger amount that requires surgery as part of the treatment plan.

Indications for Surgical-orthodontic Treatment

If the patient has a malocclusion with a good skeletal jaw relationship, orthodontic tooth movement alone is usually sufficient to correct a crowded and irregular dentition. Ackerman and Proffit[6] clearly delineated the esthetic guidelines that should be used when evaluating the soft-tissue integument. These investigators suggest as follows:

- Protraction of the incisors would be preferable in a patient with a large nose or chin, providing there would not be excessive deepening of the mentolabial fold.
- Orthodontics alone can rarely correct severe midface deficiency or mandibular prognathism because these two conditions often are accompanied by unesthetic lip position and neck form.
- Moderate amounts of mandibular deficiency are often acceptable to patients, although the orthodontist might prefer more prominence of the lower face.
- Maxillary incisors should never be retracted to the point that the inclination of the upper lip becomes negative to a true vertical line.
- Protrusion of the incisors is excessive and unesthetic if the protruding teeth cause lip separation greater than 4 mm at rest and lip strain to gain lip seal creates an ill-defined mentolabial sulcus, and orthodontic retraction of the protruding incisors is indicated.

Surgical-treatment Objectives

The postsurgical profile of the patient can be predicted with some degree of accuracy by cephalometric means. This is called as 'surgical-treatment objective (STO)' or 'prediction tracing'.[7,8] It is a two-dimensional visual projection of the changes in osseous, dental, and soft tissues as a result of orthodontics and orthognathic surgical correction of the dentofacial and occlusal deformity.

The purpose of the STO is threefold:

- Establish presurgical orthodontic goals,
- Develop an accurate surgical objective that will achieve the best functional and esthetic result,
- Create a facial profile objective which can be used as a visual aid in consultation with the patient and family members.

Computer Prediction

The following are the steps in computer image prediction.

- An image of the lateral cephalogram is scanned into the patient's computer file.
- An 'electronic tracing' is produced, either by digitizing directly from the cephalogram as shown here or by using a digitizing pad to enter point from a pencil tracing.
- The patient's profile image is captured and entered into tile, either with a digital camera or by scanning a slide. It is important to capture the image in natural head position (and that the cephalogram also be taken in natural head position) and that the image be as closely oriented to the cephalogram as possible in terms of rotation of the head and soft-tissue repose (the lips should be relaxed for both the cephalogram and profile image).

For this patient, note the long lower face height, lip incompetence, prominent nose, and mandibular deficiency.

- The digital tracing is then 'sized' to fit and coordinate with the facial image, using the profile as the overlay reference. The small boxes on the teeth and jaws seen at this point represent treatment 'handles' by which the teeth and osseous segments can be moved with the computer mouse in simulation of treatment changes.
- The treatment algorithms are displayed here in table form. It is important that the clinician has the ability to change the algorithms as research produces new data on the soft-tissue response to orthodontic and surgical movements.

Presurgical Orthodontics

In general, the goal of presurgical orthodontics is to position the teeth, allowing an optimal surgical correction of the jaw bones. This will make the malocclusion look worse presurgically, but it will show the true entity of the skeletal problem, thus facilitating an optimal surgery.[9] Our aims from the presurgical treatment were to decompensate the upper and lower incisors and to level and align both arches and relief of crowding in the lower arch.

Upper and lower first premolars were extracted to get space for retracting the lower incisors, alleviation of lower arch crowding, uprighting the upper incisors, and severing dental class II relation. The patient received 0.018" Roth edgewise appliance. Initial leveling was accomplished with 0.016" nickel-titanium (NiTi) arch wires. Anchorage was maximized in the maxillary arch by inserting a transpalatal arch in addition to bonding the 2nd molars. After initial leveling and alignment, the upper and lower cuspids were retracted; lower incisors were decompensated, and a space left in the upper premolars area for anterior maxillary was set back.

Reverse Orthodontics[9]

One of the major goals of presurgical orthodontics is to eliminate the dental compensation.

- In this stage, deliberately the condition is made worse by decompensation.
- Hence, this part of treatment is also called reverse orthodontics.
  i. Decompensation in class II
- The upper incisors are left in their original position or if required advanced.
- The lower incisors are retracted.

- This causes increase in overjet and thereby increases the distance, mandible can be advanced, or maxillar can be set back.

ii. Decompensation in class III

- The lower incisors are maintained in position or advanced.
- Upper incisors are retracted, increasing the reverse overjet.
- It also increases the distance mandible can be set back or maxilla advanced.

FACE BOW TRANSFER

- To record the relation of the max to the hinge axis (condyle)
- To establish the same relation b/n the max cast and the mechanical hinge of the articulator

MODEL SURGERY

Model surgery is the dental cast version of cephalometric prediction of surgical results. Typically, model surgery is done just prior to the actual surgery, after orthodontic preparation have been completed, so there is no need to reposition the teeth on the casts, but a simulation of final occlusion can be seen prior to any treatment if diagnostic has been done. Patients depicting vertical maxillary excess with prognathism invariably require LeFort I osteotomy with maxillary segmentation and maxillary first premolar extractions during surgery.

OCCLUSAL WAFER SPLINT

- Provides a clearly visualized goal for the surgeon at the operating table
- Aids in positioning bone fragments correctly
- Possible to put teeth in a planned position at surgery, even if they do not integrate perfectly without a splints thick splints can introduce errors if articulator mounting is not accurate, there is great possibility of error when the mandibular rotates into position
- Splint removal postsurgically must occur simultaneously with removal of stabilizing wires.

SURGICAL PROCEDURES

Surgical Correction of Class II Malocclusion

The various methods of surgical correction for skeletal class II malocclusion[9,10] can be studied under three different situations. Patients with normal maxilla and mandible, but with receding chin.

1 Prognathic maxilla
   - *Prognathic maxilla with deficient chin*: Wassmund procedure in maxilla and sliding genioplasty.
   - *With prominent chin*: Wassmund procedure in maxilla with reduction genioplasty.
   - *With normal chin*: Wassmund procedure to reduce the prominence of the premaxillary.

2. Retrognathism mandible
   - The intraoral sagittal ramus osteotomy (BSSO) was described by Trauner and Obwegeser in 1957. Modifications to the original surgical technique have been numerous. In addition to the technical modifications at surgery, modern surgical and anesthesia practices have improved the patient's outcome.
   - The bilateral sagittal split osteotomy is evaluated as an ambulatory surgical procedure. Bilateral sagittal split osteotomy[11] (BSSO) of the mandibular ramus done from an intraoral approach is the preferred procedure.

Bilateral split permits the mandible to advance to new position.

The lower incisor segment may be lowered and chin contour improved as necessary by Kole procedure. Other advancement procedures are: inverted L osteotomy, Eiselbug's Z-shaped body osteotomy.

Long Face[12]

Patients are treated by superior repositioning of the maxilla.

Superior repositioning with Le Fort I down fracture of maxilla after removal of bone from the lateral walls of the nose, sinus and nasal system.

Mandible responds to the surgery by upwards and forwards autorotation.

New muscular adaptation stabilizes the position.

Excellent stability of the vertical position of the maxilla is seen postoperatively.

Short Face[12]

Patients are surgically treated by sagittal split mandibular ramus surgery.

- The mandible is rotated slightly forward and down.
- Gonial angle area is placed up.

Adjunctive-surgical Procedures

Recession of Chin[13] associated with normal mandible is seen in the following conditions:

- As a hereditary feature.
- Trauma to chin.
- After orthodontic correction of dentoalveolar problem.

Methods of correction: The receding chin may be corrected surgically by:

1. *On lays to the chin*: It may be in the form of autograft, homograft and allograft.
   - Autograft on lays:
     - On lay bone grafts to the chin may be inserted through intraoral or sumental approach.
     - A block of iliac crest bone is contoured and used as a graft.

     Grafts are held in position by transosseous wiring.
   - Homograft on lays:
     - Homograft on lays are used similar to autograft on lays.
     - They are less reliable and more prone for infection.
   - Allograft on lays: various allografts like tantalum, stainless steel, chrome-cobalt, and silastic have been tried. Most unsatisfactory method in long-term.
2. *Sliding genioplasty*: Obwegeser described sliding genioplasty in the year 1957.

   In this procedure, bone is sectioned backwards from the chin.

   The sectioned lower fragment is advanced to create a mental prominence.
3. *Esthetic lip surgery*: In dentofacial patients, the primary procedure is demobilization of a hyper mobile upper lip to decrease excessive exposure of gingiva on smile when this is created by too much elevation of the 'lip curtain.' Reduction cheiloplasty is an unpredictable procedure, and although it could be considered in reduction of excessive lip prominence, it is rarely used for this purpose.
4. *Lengthening of the short philtrum*: A short philtrum can contribute to excessive incisor display, and lengthening it is one possible solution to this problem. Correction of the short philtrum in the adult may be accomplished through the use of V-V cheiloplasty performed as an isolated procedure or in combination with LeFort I osteotomy.

Postsurgical Orthodontics

Postsurgical orthodontics can begin when the surgeon thinks the healing has reached the point of satisfactory clinical stability with wire osteosynthesis and maxillomandibular fixation, clinical healing to this level requires 6 to 8 weeks after mandibular osteotomy, perhaps a bit less with maxillary osteotomy with rigid internal fixation, healing probably does not occur more quickly, but the bony segments are more stable from the beginning, allowing the patient limited early function. Finishing orthodontics may be possible starting at 3 or even 2 weeks after surgery, rather than beginning at 6 to 8 weeks.

This remains a matter of the surgeon's judgment. The first step in postsurgical orthodontics is to remove the splint and the stabilizing arch wires. These should be removed at the same time, by the orthodontist, once the splint and stabilizing wires have been removed, the orthodontist needs to place working arch wires and begin the process of settling the teeth into class III occlusion.

Typical working wires are a flexible rectangular wire in the upper arch (usually 17 × 25 TMA in 18-slot, 19 × 25 TMA or 21 × 25 Nitinol in 22-slot) and an undersized round wire, such as 16 steel, in the lower arch. These must allow the necessary elongation of some teeth and faciolingual tipping of the teeth in at least one arch as interdigitation of the teeth develops. If postsurgical movement of teeth in only one arch (usually the lower arch) is desired, the stabilizing arch wire can be retained in the other arch.

RETENTION AND STABILITY

Stability is a key[13,14] goal of orthodontic treatment and orthognathic treatment; the long-term stability of changes resulting from the surgical procedures has been an area of major concern. Because the final, long-term result, both esthetic and functional, is directly related to the degree of postsurgical stability. The experience and expertise of the surgeon undoubtedly is also a factor in the stability of the result.

SUMMARY AND CONCLUSION

Jaw deformities may cause pain, dysfunction, excessive tooth wear, and difficulty chewing, speaking, or breathing. Many people live with these problems all their lives, but there is an alternative. Restoring the proper anatomic relationship of the jaw helps reestablish normal function[13] and helps protect against further deterioration of the teeth and the temporomandibular joints (TMJs). The scope of the orthodontist's treatment capability and at the same time has expanded the orthodontist's responsibilities. Combined treatment provides a valuable insight from his medical experience to orthodontists and surgeons.

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