Speedy orthodontics - Surgery first orthognathic approach

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Abstract
Skeletal malocclusions are the result of variation in the relationship between skeletal, dental and overlying soft tissues. Management of these malocclusions in adults requires orthognathic surgery in combination with orthodontics. Until 1960s, surgeons and orthodontists worked independently to correct dentofacial deformities. Thereafter, the conventional approach for correction of severe dentofacial anomalies was introduced which consisted of three stages (presurgical, surgical, postsurgical). As treatment with conventional orthognathic surgery involves a prolonged time period, surgery first orthognathic approach (SFOA) was introduced in which orthognathic surgery is done first followed by orthodontic treatment for alignment of the teeth and settle the occlusion. By performing surgery first approach, Regional Acceleratory Phenomenon (RAP) is initiated which is an important factor in reduction of treatment duration in SFOA. This article intends to provide an overview of the history, indications, advantages, disadvantages, stability of SFOA.

Keywords: Skeletal malocclusions, Conventional orthognathic surgery, Surgery first orthognathic approach, Regional acceleratory phenomenon.

Introduction

Facial beauty is considered as an important feature in our society. 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, dentoalveolar and soft tissue deformity of the jaws and associated structures. Hullihen[1] was the first to coin the term orthognathic surgery in 1849. In 1957, Trauner and Obwegeser,[2] introduced the mandibular sagittal split ramus osteotomy, which marked the beginning of the modern era of orthognathic surgery. Until 1960s, surgeons and orthodontists worked independently to correct dentofacial deformities. Soon, it became apparent that there were problems if surgery was done first. Neither the orthodontists nor the surgeon understood the others' treatment limitations.[3]

These problems were resolved by conventional orthognathic approach which include three stages-presurgical, surgical, post surgical. Disadvantages of conventional orthognathic surgery are that it is time consuming, requires two phases of orthodontic treatment, temporary worsening of facial profile, gingival recession, masticatory discomfort and soreness. To overcome the above challenges involved in presurgical orthodontics, surgery first orthognathic approach (SFOA) was introduced which performs directly an orthognathic surgery, without orthodontic preparation, followed by a post-surgical orthodontic phase.

The issue of surgery first approach was first raised by Skaggs[4] in 1959. Later the concept of surgery first and orthodontics second, was introduced by Behrman and Behrman[5] in 1988. In 1991 Brachvogel[6] et al defined further potential advantages of this approach as the dental arch alignment after surgery is similar to orthodontic treatment in any class I case, and that possible postsurgical relapse can be easily addressed with postoperative orthodontics. Later Surgery first approach (SFA) was proposed by Nagasaka[7] et al in 2009 at Tohoku University in Sendai, Japan for patients with skeletal deformity. They stated that surgery first approach has two significant advantages: immediate correction of soft-tissue deformities and reduced treatment time.

Uribe[8] et al stated that SFOA significantly reduces treatment duration in orthognathic surgery. Pelo[9] et al proposed that worsening of the facial profile during the traditional orthognathic surgery had a negative impact on the perception of patients quality of life that surgeons should consider the possibility of a surgery-first approach to prevent this occurrence.

Depending on the specific characteristics of the malocclusion and the dentofacial deformity surgery first approach is indicated in a variety of cases. Some of the features that the malocclusion that posses include[3]:

1. Well aligned to mildly crowed anterior teeth
2. Normal to mild proclined/retroclined incisor inclination
3. Flat to mild curve of spee
4. Minimal transverse discrepancies.
5. Pronounced soft tissue imbalance in skeletal class III patients.
6. Cases in which decompensation is not required.
7. Patients who want immediate esthetic result or who want to improve both function and esthetics.
8. At least three stable occlusal stops with positive overbite of six anterior teeth and existing arch coordination.
9. The patients should be of appropriate age to proceed with surgery.

The cases in which surgery first approach is contraindicated are

1. Patients who require definite decompensation
2. Severe crowding and arch-incoordination
3. Severe vertical or transverse discrepancy
4. Patients with high expectations of treatment outcomes in terms of dental esthetics and stable occlusions.
5. Severe proclination of upper and lower anteriors.

The advantages of surgery first approach include immediate change in the facial profile, reduced overall treatment period, efficient and effective orthodontic decompensation on the other hand in conventional orthognathic surgery there is temporary worsening of profile, overall treatment period is longer due to prolonged period of presurgical orthodontic phase. On an average conventional orthognathic surgery takes a period of 18-36 months whereas it is dramatically reduced 9.6-13.4 months to in surgery first approach.[8] Orthodontic tooth movement is easier in the less-occluded dentition, which occurs mostly after the surgery in SFA.[10,11] If a surgical error or skeletal relapse occurs, compensation can be made with Skeletal anchorage system mechanics.[9]

Every procedure has its own drawbacks. Some of the drawbacks of surgery first approach are: Predicting the final occlusion is the hardest challenge, Patient must wear an occlusal splint while eating to overcome potentially unstable occlusion, impacted mandibular third molars could add difficulty to surgery, the bending procedure for a passive surgical wire is time consuming and complex and the requirement for more surgical movement to compensate for postoperative orthodontic movement.[9,11]

Diagnosis in Surgery first Orthognathic Approach

1. Conventional diagnosis
2. 3D diagnosis

Conventional diagnosis is made through clinical examination with the aid of photographs, radiographs (OPG, Lateral cephalogram, PA cephalogram Submento-vertex view), intraoral dental models and Model surgery. The most widespread and standard method by which surgical planning is achieved is by the use of conventional paper and model surgery. However, the limitation of these conventional techniques results from using 2-dimensional tools to attempt an accurate prediction of 3-dimensional surgical and orthodontic movements. Moreover, conventional planning techniques do not provide a final 3-dimensional visual treatment objective to further guide surgical and orthodontic precision.

Computer aided surgical simulation (CASS) utilizing 3-dimensional images obtained from multi-slice computer tomography (MSCT)/cone beam computer tomography (CBCT) have been successfully performed to plan craniofacial surgery. Gateno[12] et al assessed the precision of digitally generated surgical wafers with conventional splints and found a high degree of accuracy with the computer-generated splints.

SFOA can potentially produce semistable postsurgical occlusion compared with the conventional orthognathic surgical approach. Therefore, a rigid fixation has been suggested for maintaining the occlusion stability postoperatively. Even if the occlusion is not completely set, setting a wafer after operation minimizes the post-operative occlusion instability. Sequence of treatment in SFOA includes:

1. Preoperative procedures
2. Surgical procedure
3. Post-surgical orthodontic procedure

Although bonding the wire directly to the teeth is very fast, it makes post-surgical orthodontics a problem since teeth need to be bonded at that point. Given the healing period after surgery, it is very difficult to place brackets on teeth while minimizing patient discomfort. While some clinicians prefer to bond the wire directly to the surface of teeth, others choose to utilize the conventional orthodontic attachments.

Duration of usage of splints in SFOA

The usage of the splint only during surgery was advocated by some authors, while others have advocated its use anywhere between one to four weeks after surgery. Removable Gelb–type splints have been used post operatively by Nagasaka[6] et al and their preference is to leave the splint in for about 4 to 6 weeks after surgery. It was then modified into a removable maxillary occlusal splint by Sugawara[13] et al. The BSSO technique in SFOA requires 1 to 2 weeks of occlusal splint postoperatively, while intraoral vertical ramus osteotomy (IVRO) technique requires approximately 4 weeks of occlusal splint owing to the difference in amount of bony overlap and healing process.

BSSO provides primary stability by rigid fixation of bony segments; interfacing the marrow; in contrast, IVRO has overlapping bony segments interfacing cortices (cortex-to-cortex healing). These bony segments become more rigid and muscular reattachment sequentially follows.[14] Thus, it takes approximately 4 weeks for mandibular proximal and distal bony segments to heal and fuse together, and the occlusal splint is used to stabilize the occlusion during this bone-healing period. Orthodontic treatment begins 2 weeks after the surgery.

Use of Skeletal Anchorage in Conjunction with Surgery first Approach

The use of skeletal anchorage has provided for more predictable orthodontic movements while minimizing the undesirable side effects. Nagasaka et al[7] used surgery first orthognathic approach combined with skeletal anchorage system mechanics to provide significant benefits to skeletal class III patients compared with traditional surgical orthodontic

treatment. The combination of "surgery first" treatment with the skeletal anchorage system (SAS) has a number of advantages, including a notable reduction in treatment time, increased bone turnover after orthognathic surgery which can significantly accelerate orthodontic tooth movement, ease of achieving difficult movements such as intrusion and distalization, normalized relationship between the jaws and orofacial muscles, which contributes to effective tooth movement and further expedites the postsurgical orthodontic phase, postsurgical correction of any relapse tendencies or slight discrepancies between the planned and actual surgical outcomes. The concept of SF that we practice is the orthodontic-driven style, referred to as Sendai SF (SSF). This approach was made possible by the application of the Skeletal Anchorage System (SAS) which enables predictable control of the entire dentition, including three-dimensional control of the bimaxillary molars.[15]

Finally, the percentage of nonextraction cases has increased significantly because the SAS permits distalization of the entire dentition, taking advantage of the spaces created by third-molar extractions during surgery, However, the drawback is that the orthodontist must be skilled in the SAS technique, which is essential in achieving predictable three dimensional molar movement.[16]

Regional Acceleratory Phenomenon

The regional acceleratory phenomenon (RAP) was described by Frost in 1989.[17] This phenomenon can be utilized by the orthodontist following orthognathic surgery to accelerate tooth movement. This short period of regional acceleratory phenomenon is a possible explanation for shortened treatment time in surgery first orthodontics. This effect can be seen upto 4 months postsurgically. Hernandez-Alfaro[18] et al stated that the orthodontic treatment is shortened to an average of 37.8 weeks and this implies that dental movements are significantly expedited. The improved efficiency of orthodontic forces is significantly related to the process of demineralization and remineralization consistent with the wound-healing pattern of the RAP.

The period for post-operative inter-digitation is about 2-3 months. During this period, Orthodontists rapidly set the occlusion between upper and lower molars and adjust the width of the molar areas. Levelling and alignment, decompensation, arch coordination, detailing of occlusion are carried out.

Treatment Planning Considerations

Careful planning is necessary in any orthognathic surgery case, especially when the surgical procedure is to be performed prior to orthodontic treatment. Teeth will be decompensated to normal positions and angulations following surgery; therefore, the transitional occlusion must allow for post-surgical movement of teeth. Since the incisors cannot be used as a guide to predict the final occlusion in surgery first cases, the molar relationship is utilized as a starting point to come up with a temporary occlusion. The inclination of upper incisors is important in determining the need for possible extractions. If the upper incisor is excessively proclined, extractions may be considered to allow retraction of upper incisors post-operatively.[3,19]

Postoperatively, when placing upper and lower models into occlusion, the transverse dimension of the arches in many cases does not allow perfect interdigitation. The midlines must be coincident or close to it after surgery and proper buccal overjet must be established bilaterally. Prediction of the final occlusion based on the current position of teeth is the most challenging and time consuming step in preparing for surgery first orthodontics.

The term Intended transitional malocclusion (ITM) is used to describe the occlusion which will be used to fabricate the surgical splint and is the surgeon's guide during surgery.[3] At least a three-point contact must be established between the upper and lower models when deciding on the ITM[19] and temporary occlusion can be guided by using molar relationship as starting point[20]. In order to relieve some of the interferences, where such temporary occlusion cannot be established it is advisable to initiate some orthodontic movement. The vertical problems are usually related with anteroposterior problems and should be corrected with posterior maxilla impaction or postoperative orthodontic treatment depending on whether the problems are associated with dental interferences which are not corrected before surgery.

In class II Division 1 Malocclusions: SFOA may be particularly beneficial for a class II patient with a retrusive mandible. Immediately after surgery, class II malocclusion becomes a super class I or class III relationship following mandibular advancement, with an edge-to-edge incisor relationship or bimaxillary dentoalveolar protrusion. This situation therefore requires the use of class III orthodontic mechanics or it can also be corrected by extracting all first premolars followed by retraction as in class I bimaxillary protrusion cases.[13,21]

In class II Division 2 Malocclusions: In class II division 2 cases, it is difficult to perform SFOA as there is a less overjet. In such cases, orthodontics can be performed to obtain sufficient overjet for the advancement of mandible for correction of skeletal deformity (or) SFOA procedure can be performed directly without presurgical orthodontics by getting reverse overjet.

In class III Malocclusions: When surgery is performed first, a class III malocclusion usually becomes class II relationship immediately after mandibular setback which should be maintained with surgical splint and requires class II orthodontic mechanics after surgery and adjustment of the anterior teeth can be managed postoperatively.[21]

Treatment Considerations in Asymmetric Malocclusions using SFOA

Symmetry is considered a hallmark of facial attractiveness. Skeletal asymmetries generally require surgical intervention to improve facial esthetics and correct any associated malocclusions. The classic approach involves a presurgical phase of orthodontics, during which dental compensations are eliminated, and a postsurgical phase to refine the occlusion. SFOA now makes it possible to eliminate the presurgical orthodontic phase and to correct minor surgical inaccuracies and esthetically benefit to the patient. In these cases, SFOA includes asymmetrical single-jaw surgery to correct the asymmetry.

The MEMO strategy (Maximum efficient/ minimum orthodontic strategy) consisted of minimum preoperative orthodontic treatment, preparation for surgery and postoperative orthodontic treatment. In most cases, for treatment efficiency, the orthodontist suggest minimum pre-operative orthodontics treatment approach for a couple of months before surgery for levelling and alignment, decompensation and arch coordination. In addition, occlusal prematurity can also be removed by this procedure. The rest of the procedure after minimum preoperative orthodontic treatment is almost same with the SFOA procedure.

Stability in SFOA

In surgery-first orthodontic treatment, postoperative occlusal instability results primarily from premature contact of the extruded upper second molar.[22] Additionally, premature contact induces postoperative occlusal instability, increased vertical dimension, and postoperative forward mandibular movement. In a study carried out by Ching et al,[23] to compare postsurgical stability of skeletal class III malocclusion with and without presurgical orthodontic treatment, the SFOA group had greater amount of relapse rate (27.8% ±4 mm). The usage of temporary anchorage devices, such as miniscrews and miniplates, compensates for surgical error or skeletal relapse. Results from various studies confirm that the predictability and stability of anteroposterior movement of mandible in surgery-first using IVRO is more.[7,24] However, a surgical stent can be used to control occlusal instability after surgery-first orthodontic treatment.[7,25] Surgical accuracy can be improved with 3-dimensional prediction and printing surgical wafers thereby avoiding clockwise rotation of the proximal segment and to keep the medial pterygoid and masseter muscles in the distal segment to reduce relapse.[26]

Conclusion

Surgery first approach offers an alternative to the conventional orthognathic surgery for correction of maxillofacial deformity. The final outcomes, in the form of facial esthetics, dental occlusion, and stability, are similar when using orthodontics first and surgery first approaches. Dental occlusion and facial esthetics can show immediate improvement after surgery when using a surgery first approach. The phenomenon of postoperatively accelerated orthodontic tooth movement also reduces the difficulties associated with and the time spent on postoperative orthodontics.

References

1. Poulton DR, Ware WH. The American academy of oral roentgenology joins our Journal. *Oral Surg Oral Med Oral Pathol.* 1959:12:389-90.
2. Trauner R, Obwegeser H: The surgical correction of mandibular prognathism and retrognathia with consideration of genioplasty. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1957:10:677.
3. Kim JH, Mahdavie NN, Evans CA. Guidelines for "surgery first" orthodontic treatment. In Orthodontics-basic aspects and clinical considerations 2012. In Tech;265-300.
4. Skaggs JE. Surgical correction of prognathism. *Am J Orthod.* 1959;45:265-71.
5. Behrman SJ, Behrman DA. Oral surgeons considerations in surgical orthodontic treatment. *Dent Clin North Am.* 1988:32:481-507.
6. Baek SH, Ahn HW, Kwon YH, Choi JY. Surgery-first approach in skeletal Class III malocclusion treated with 2- jaw surgery: evaluation of surgical movement and postoperative orthodontic treatment. *J Craniofac Surg*. 2010;21:332–338.
7. Nagasaka H, Sugawara J, Kawamura H, Nanda R. Surgery first skeletal class III correction using the skeletal anchorage system. *J Clin Orthod.* 2009;58(2):97-105.
8. Uribe F, Adabi S, Janakiraman N, Allareddy V, Steinbacher D, Shafer D, Villegas C. Treatment duration and factors associated with the surgery-first approach: a two-center study. *Progress in orthodontics.* 2015;16(1):16-29.
9. Pelo S, Gasparini G, D'Amato G, Saponaro G, Moro. A Surgery-first orthognathic approach vs traditional orthognathic approach: Oral health-related quality of life assessed with 2 questionnaires. *Am J Orthod Dentofacial Orthop.* 2017;152:250-4.
10. Le Yang, Yu-dong Xia, Yu-jie Liang, Xi Wang, Jing-yuan Li, Gui-qing Liao., Does surgery-first approach get better outcomes in orthognathic surgery? A systematic review and meta-analysis. *J Oral Maxillofac Surg.* 2017:75(11):2422-9.
11. Peiro-Guijarro, Guijarro-Martınez, and Hernandez-Alfaro. Surgery first in orthognathic surgery: A systematic review of the literature. *Am J Orthod Dentofac Orthop.* 2016;149:448-462.
12. Gateno J, Xia J, Teichgraeber JF, Rosen A, Hultgren B, Vadnais T. The precision of computer-generated surgical splints. *J Oral Maxillofac Surg.* 2003;61:814-7.
13. Sugawara J, Aymach Z, Nagasaka H, Kawamura H, Nanda R. "Surgery First" Orthognathics to Correct a Skeletal Class II Malocclusion with an Impinging Bite. *J Clin Orthod.* 2010;56(7):429-438.
14. Park KR, Kim SY, Park HS, Jung YS. Surgery-first approach on patients with temporomandibular joint disease by intraoral vertical ramus osteotomy. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2013;116:429-436.
15. Sugawara J, Nagasaka H, Yamada S, Yokota S, Takahashi T, Nanda R. The application of orthodontic miniplates to Sendai surgery first. *Semin Orthod.* 2018;24(1):17-36.

16. Aymach Z, Sugawara J, Goto S, Nagasaka H, Nanda R. Nonextraction "Surgery First" Treatment of a Skeletal Class III Patient with Severe Maxillary Crowding. *J Clin Orthod.* 2013;57(5):297-304.
17. Frost HM. The biology of fracture healing. An overview for clinicians. Part I. *Clin Orthop Relat Res*. 1989;248:283-93.
18. Alfaro FH, Feboms, Mart RG and Peiro-Guijarro MA. Surgery First in Orthognathic Surgery: What Have We Learned? A Comprehensive Workflow Based on 45 Consecutive Cases. *J Oral Maxillofac Surg.* 2014;72:376-390.
19. Liao YF, Chiu YT, Huang CS, Ko EW, Chen YR. Presurgical orthodontics versus no presurgical orthodontics: Treatment outcome of surgical‐orthodontic correction for skeletal class III open bite. *Plast Reconstr Surg.* 2010;126:2074‐83.
20. H. B. Yu, L. X. Mao, X. D. Wang, B. Fang, S. G. Shen: The surgery-first approach in orthognathic surgery: a retrospective study of 50 cases. *Int J Oral Maxillofac Surg.* 2015;44:1463–1467.
21. Liou EJW, Chen PH, Wang YC, Yu CC, Chen YR. Surgery-First Accelerated Orthognathic Surgery: Orthodontic guidelines and setup for model surgery. *J Oral Maxillofac Surg.* 2011:69(3):771–780
22. Ching Ko EW, Lin SC, Chen MR, and Huang CS. Skeletal and dental variables related to the stability of orthognathic surgery in skeletal class III malocclusion with a surgery-first approach. *J Oral Maxillofac Surg.* 2013:71:215-223.
23. Ching KO EW, Pin Hsu SS, Hsieh HY, Wang YC, Huang CS, and y Chen YR. Comparison of Progressive Cephalometric Changes and Postsurgical Stability of Skeletal Class III Correction with and Without Presurgical Orthodontic Treatment. *J Oral Maxillofac Surg.* 2011;69:1469-1477.
24. Kim JY, Junga HD, Kimb, SY, Parka HS, Junga YS. Postoperative stability for surgery-first approach using intraoral vertical ramus osteotomy: 12 month follow-up. *British Journal of Oral and Maxillofacial Surgery*. 2014;52:539–544.
25. Rhee CH, Choi YK, Kim YL, Park SB, Son WS. Correlation between skeletal and dental changes after mandibular setback surgery-first orthodontic treatment: Cone-beam computed tomography-generated half-cephalograms. *Korean J Orthod*. 2015;45(2):59-65.
26. Lian YK, Hsieh AM, Tsai MS, Jiang HR, Yen CY, Hsia YJ, Lee SY. Treatment efficiency and stability of skeletal Class III malocclusion with a surgery-first approach. *Orthodontics & craniofacial research.* 2018;21(2):90-5.