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Surgery First Orthognathic Approach in the Correction of Dentofacial Deformities - An Overview

Research Article

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Abstract

Dentofacial deformities are corrected by orthognathic surgery and there are two approaches: orthodontics-first approach and surgery-first approach. In orthodontics-first approach, the orthodontic treatment precedes the orthognathic surgery, whereas in the surgery-first approach, the orthognathic surgery precedes the orthodontic treatment. Surgery first orthognathic approach [SFOA] is defined as orthognathic surgery without presurgical orthodontics.Compared to conventional surgery, SFOA reduces the overall treatment time, achieves immediate aesthetics and adequate postoperative stability in selected cases. In SFOA, treatment time canbe substantially reduced by eliminating the presurgical phase and taking advantage of regional accelerated phenomenon for postsurgical orthodontics. SFOA is a good alternative to conventional orthognathic surgical procedures in skeletal malocclusion cases [especially in Class III and asymmetry patients]. A team approach between surgeons and orthodontists is vital for successful outcomes with SFOA. Thus, with the advent of SFOA, there is a paradigm shift in the traditional orthognathic approach. This article discusses about the indications, contraindications, advantages, disadvantages and relapse rate of SFOA, impact of regional acceleratory phenomenon on postsurgical orthodontics, and delineates the differences between SFOA and conventional orthognathic approach in the correction of dentofacial deformities.

Keywords: Orthognathic Surgery; Relapse; Stability; Surgery First Approach; Treatment Time; Aesthetics; Orthodontics.

Introduction

Malocclusion or deformity in orofacial structures can be classified as dental deformity or skeletal deformity. Deformity involving only dental structures is called as dental deformity, whereas deformity associated with basal or skeletal bone is called as skeletal deformity. Dental deformities can be treated orthodontically, whereas skeletal deformities require surgical intervention and orthodontic correction. Skeletal deformities can be excess or deficient in maxilla or mandible or in both jaws. Dentofacial deformities can occur in three dimensions namely vertical, anteroposterior and transverse dimensions involving dental and skeletal components [1].

Secondary deformity occurs due to a primary pathology in dentofacial structures. Secondary deformities include genial deformity [pro/retrogenia], facial asymmetry [condylar hyperplasia/hypoplasia, hemifacial microstomia], cleft deformities [maxillary hypoplasia], nasal deformity, and craniofacial deformities [Crouzon's syndrome/Trachear Collins syndrome/Pierre Robin syndrome] [2]. Surgery is the predominant treatment for secondary deformities followed by orthodontic treatment if necessary.

Orthodontic treatment is predominantly done for cases requiring maxillary expansion [Surgically assisted maxillary expansion (SAME) or surgically assisted rapid palatal expansion (SARPE)],canine distalization [wilkodontics], and severe spacing [Pre-orthodontic surgery, corticotomy or surgically assisted orthodontics]. In all these cases orthodontic treatment is carried out with minimal surgical assistance [3].

Dentofacial deformities are corrected by orthognathic surgery and there are two approaches: orthodontics-first approach and surgery-first approach. In orthodontics-first approach, the orthodontic treatment precedes the orthognathic surgery, whereas

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in the surgery-first approach, the orthognathic surgery precedes the orthodontic treatment. The conventional approach is an orthodontics-first approach. The traditional orthognathic approach includes three phases: presurgical orthodontic treatmentfor approximately 12 to 18 months, the orthognathic surgical procedure itself, and then postsurgical orthodontic treatment for approximately 6 to 12 months [4]. Later surgery first orthognathic approach [SFOA] evolved which consisted of surgery followed by orthodontic treatment.

Conventional Orthognathic Approach

Presurgical Orthodontics

This is the main goal of presurgical orthodonticsin conventional orthognathic surgery is decompensation. Compensation present in skeletal deformities has to be decompensated by presurgical orthodontics and it requires a minimum of 8-12 months of time. The aims of presurgical orthodonticsare: positioning the teeth to their respective basal bone, aligning and levelling the teeth, adjusting for the tooth size discrepancy, correction of rotated teeth, root adjustment for the surgical site, and co-ordination of upper and lower arch width. This is utilized in the conventional management of dentofacial anomalies, requiring a varied period of pre-surgical orthodontic treatment and is important for adequate surgical treatment and stable results especially in cases of skeletal Class III occlusion [5].

Disadvantages of presurgical orthodontics are: exaggerated malocclusion during the decompensation phase, poor aesthetics, need of postsurgical orthodontics for final settling of occlusion, and prolonged treatment time.

Surgery First Orthognathic Approach

SFOA is defined as orthognathic surgery without presurgical orthodontics. SFOA can also be defined as skeletal first approach as it involves correcting skeletal deformities first followed by dental malocclusion during postsurgical orthodontics. However, in cases of severe occlusal prematurity, SFOA is performed with minimal orthodontic procedures utilizing bracket and wire placement. Orthodontics is started few days to a couple of months before surgery and is termed as minimal presurgical orthodontics in SFOA [6].

Indications for SFOA

SFOA is indicated in patients with well-aligned to mildly crowded anterior teeth, flat to mildly curve of Spee, normal to mildly proclined/retroclined incisor inclination, skeletal class III malocclusion [mandibular setback of less than 15 mm], mild facial asymmetry, bimaxillary protrusion, normal interincisal angle, minimal overbite, cases not requiring extractions Although SFOA is done predominantly for skeletal class III cases, it can also be utilized for class II and class I malocclusion and cases with minimal discrepancies in the sagittal, transversal and vertical planes. Ability to achieve at least three occlusal contact points between the arches post-surgery is an important requirement to perform SFOA [7].

Contraindications for SFOA

SFOA is contraindicated in patients with severe crowding, vertical discrepancies, transverse discrepancies, severe facial asymmetry, severe open bites, cleft related dentofacial deformity, centric relation-centric occlusion discrepancy, maxillomandibular canine interferences, excessive occlusal interferences, cases where unilateral or bilateral cross-bite or scissor-bitemay occur postoperatively and in cases where postoperative orthodontics is not predictable [7].

Splint Construction for SFOA

SFOA involves sophisticated presurgical dental modelling and meticulous postoperative orthodontic finishing. Simulation of the dental model after the orthognathic surgery without presurgical orthodontic treatment will provide better predictive capability to avoid possible postoperative occlusal instability. During splint construction for SFOA, individual tooth alterations in dental model is done similar to presurgical orthodontics procedure. 'Surgical temporary occlusion'mimicking the presurgical orthodontics is obtained by mock surgery in the mounted dental model in the articulator. A surgical splint on dental model reflecting the orthognathic procedure is then fabricated. Now-a-days 3D virtual orthodontic treatment and surgery plays a major role in the treatment planning and surgical splint construction for SFOA. Accurate prediction and simulation of the postoperative orthodontic treatment are crucial for dental alignment, incisor decompensation, arch coordination, and occlusal settling in SFOA. The simulation process could allow us to discriminate between cases for which the SFOA would be or would not be possible [8].

Regional Acceleratory Phenomenon

Frost in 1989 suggested that reorganizing activity of osseous hardtissue adjacent to injured surgical wound is greatly accelerated and is termed as "Regional acceleratory phenomenon" (RAP). RAP occurs, not only in hardtissues, such as bone and cartilage, but also in soft tissues.This phenomenon begins a few daysafter insult and reaches its peak in 1 to 2 months. It was suggested thatwhen orthognathic surgery is performed first, it can enhance the RAP and the clinician can take advantage of this phenomenon for postsurgical orthodontic tooth movements. Localized bone formation after trauma orsurgical insult not only leads to RAP in injured regional tissues but also induces "systemic acceleratory phenomenon (SAP)" in distant skeletal structures. Therefore, accelerated tooth movement and alveolar bone remodelling during postsurgical orthodontic treatment could be attributed to both RAP and SAP [9].

C-terminal telopeptide of type I collagen [ICTP] is a boneresorption metabolite of type I collagen in bone and is associated with osteoclasts. Serum alkaline phosphatase [ALP] is an enzyme for bone formation and is associated with osteoblasts. Serum ICTPlevels and the serum ALP levels, the markers for bone turnover significantly increases in the first to fourth month postoperatively, which indicates the increase in osteoclastic and osteoblastic activities respectively. The onset of increase in ICTP (osteoclastic activities) was earlier than that of ALP (osteoblastic activities) after surgery. The orthognathic surgery triggers 3 to 4 months of higher osteoclastic activities and metabolic changes in the dentoalveolus postoperatively, which possibly accelerates postoperative orthodontic tooth movement.

RAP occurring in jaw bone could be induced by flap surgery, cor-

ticotomy, and even by a nonsurgical procedure such as orthodontic tooth movement. RAP shows peak activity in 1 to 2 months after surgery and lasts until 6 to 24 months postoperatively incase of periodontal flap surgery. It was foundthat orthodontic tooth movement could be accelerated following selective labial and lingual decortication of alveolar bone and iscalled "accelerated osteogenic orthodontics" (AOO) [9].

Postsurgical Orthodontics

Objectives of Postsurgical orthodontics in SFOA are: decompensation, detailing the occlusion, residual open bite correction, ensuring skeletal stability with molar relations, rapid tooth movement favouring natural compensation by accelerated mechanism. Because orthodontic treatment is not performed pre-operatively in the surgery first approach, there is almost unavoidable occlusal instability at surgery and the jaws may be repositioned to an undesired position due to occlusal interferences. The postsurgical orthodontic treatment makes up for omitting the presurgical orthodontic treatment and the final results and stability are similar in both conventional orthognathic surgery and SFOA. The direction of the postsurgical treatment is in line with the natural direction of spontaneous dental compensation and muscular force after orthognathic surgery, thereby decreasing the time to full compensation [7].

Orthognathic surgery triggers 3 to 4 months of higher bone metabolism postoperatively, which might accelerate orthodontic tooth movement. Thus, orthodontic treatment can take advantage of the regional acceleratory phenomenon after surgery. Post surgical orthodontics can be started immediately by one to two weeks after surgery. Several authors have initiated post surgical orthodontics between 4-8 weeks after surgery.

Relapse with SFOA

Although the magnitude of surgical movement in SFOA is larger than the conventional approach, relapse and stability with SFOA is similar and comparable to the conventional three stage orthognathic procedure [7]. The complication rate with SFOAwas actually not very different from that of traditional approach. In a study it was found that there was no significant difference in relapse rates after bilateral sagittal split ramus osteotomy for skeletal class III malocclusion with conventional orthognathic procedure and SFOA. On comparing surgery-first approach with conventional orthodontic-first approach for class III malocclusion patients, both produced good aesthetics and conventional approach has better dentoskeletal stability. The surgery-first approach shortened the overall treatment duration [10]. Another study showed that SFOA without any presurgical orthodontic treatment for correcting dentofacial deformities can achieve similar long-term vertical stability results to the orthodontic treatment-first approach [11].

Relapse or instability is more in patients with mesio-facial type, increased vertical dimension, mandibular set back procedures more than 15mm, larger open bite, deeper curve of spee, increased negative over jet, interferences of teeth [not orthodontically prepared], and difficult skeletal movements.Stability is less in mandibular prognathism correction cases without preoperative orthodontic treatment. Hence, it is better to do minimal presurgical orthodontics in such cases. Deep curve of spee and dental interferences with open bite should be corrected first. Over correction of mandibular setback or more clockwise rotation of maxillomandibular complex is desired. Subapical osteotomy [kole's procedure] is performed for severe accentuated curve of spee. Severe initial sagittal discrepancies of the arch must be treated to prevent relapse [12].

Advantages of SFOA

Compared to conventional orthognathic surgery, SFOA reduces presurgical orthodontic treatment time [12-24 months] and there is reduction in postsurgical orthodontic treatment time by upto 6 months because of accelerated orthodontics. Thus, there is reduction in overall treatment time by upto 1 to 1.5 years or fewer depending on the complexity of orthodontic treatment with no major complications. Other benefits are immediate aesthetics, regional accelerated phenomenon [accelerated post operative orthodontics], simultaneous orthodontic treatment [decompensation, arch co-ordination and occlusion settling in post operative orthodontics], no need for extraction of teeth and partial correction of dental compensation, and avoidance of aggravated facial aesthetics that occur during the presurgical orthodontic treatments, especially in class III dentofacial deformity [13].

Yu CC et alpresent a case report of 19-year-old man with mandibular prognathism [class III], anterior open bite and severe dental crowding treated with minimal pre-surgical orthodontics and SFOA. The total treatment time was only four months, and the results were not compromised. Thus, they recommend SFOA as an effective treatment alternative for conventional orthognathic surgery in selected cases [14]. According to a study, SFOA without presurgical orthodontic treatment was found to bepredictable and applicable to treat asymmetry and class III dentofacial deformities [8].

Disadvantages of SFOA

Accurate prediction of the occlusion after post-orthodontic treatment in the SFOA is extremely challenging in cases with arch width discrepancy, asymmetric transverse arch, or severe crossbite or deep bite. Compared to conventional approach, SFOA may require more surgical intervention [two-jaw surgeries] and more frequent reduction of occlusal interferences during the surgery. Management of postoperative physical therapy or guidance of postoperative occlusion in the SFOA is difficult because the occlusion is completely dependent on the surgical splint. Other problem with SFOA is bracket failure during Surgery, as brackets are placed during minimal presurgical orthodontics period [15].

SFOA versus Conventional Orthognathic Surgery

The salient features of SFOA and conventional orthognathic surgery are depicted in the Table 1.

Summary

There are twotypes of SFOA: an orthodontically driven style and a surgicallydriven style. The surgery-first approach treats facialaesthetics first and then occlusion, whereas the conventional approach treats occlusion first and then facialaesthetics. The choice of surgical technique in orthognathic surgery is based primarily

Table 1. Differences between SFOA and conventional orthognathic surgery.

Salient features	SFOA	Conventional orthognathic surgery
Presurgical orthodontics	1-4 weeks	12-18 months
Stages involved	2 stages · Jaw surgery · Postsurgical orthodontics	3 stages · Presurgical orthodontics · Jaw surgery · Postsurgical orthodontics
Postsurgical orthodontics	12-18 months	6-12 months
Facial aesthetics	Immediate improvement	Aggravation of the existing problem and poor aesthetics before surgery
Overall treatment time	1-1.5 years	3-4 years
Selection criteria	Critical for the success of the treatment [as the baseline dental relation is unable to guide post-surgery occlusion]	Non-critical, complex cases can be managed with appropriate presurgicaldecompensation
Early elimination of soft tissue and hard tissue hindrances	Possible to eliminate imbalances in the beginning of treatment due to establishment of proper maxilla-mandibular relationship and allows efficient dental correction	Worsens due to ensued decompensation

on the surgical treatment objectives (STO), and in SFOA there is a combined initial and final STO at the same time.The surgery-first approach uses osteotomy to solve both skeletal problems and dental compensation,and a "transitional" occlusion is set up post-operatively. Orthodontics in the surgery-first approach is apost-operatively adjunctive treatment to transfigure the transitional occlusion into the solid final occlusion [16]. Since the final occlusion is greatlydependent on the postsurgical orthodontic treatment,the establishment of a realistic surgical goal for finalorthodontic settlement is important. With SFOA, the entire treatment period could be shortened to 1to 1.5 years or fewer depending on the complexityof orthodontic treatment and offers immediate correction of facial deformities, thereby achieving patient satisfaction and compliance with the treatment [17]. RAP increases tissue reorganization and healing by way ofa transient burst of localized severe bone resorptionand then remodelling. Treatment time canbe substantially reduced by eliminatingthe presurgical phase andtaking advantage of regional accelerated phenomenon for postsurgical orthodontics [18]. SFOA also helps to eliminate the soft-tissue imbalances that mightinterfere with postsurgical orthodontictoothmovements [19]. Thus, the "surgery first" approachcan especially be used to treatpatients with complexdentofacial asymmetry and Class III malocclusion without compromise in stability [20, 21].

Conclusion

The SFOA can achieve similar results in correcting dentofacial deformities as the orthodontic treatment-first approach. SFOA is a good alternative to conventional orthognathic surgical procedures in selective skeletal malocclusion cases [Class III cases]. Compared to conventional surgery, it reduces the overall treatment time and good postoperative stability is achieved in selected cases. Any skeletal or occlusal condition with the potential to compromise the clinical outcome due to interferences is a contraindication for surgery first approach. However, the use of three-dimensional analysis and computer-assisted design - computer-assisted manufacture intraoperative splints may help the surgeon and the orthodontist to accurately predict the extent of the dentoskeletal correction. A team approach between surgeons and orthodontists is vital for successful outcomes with SFOA. Thus, with the advent of SFOA, there is a paradigm shift in the traditional orthognathic approach.

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