RESEARCH PAPER

Surgery First Orthognathic Approach: A Paradigm Shift in Orthognathic Treatment.

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ABSTRACT
N\A.
Keywords: N\A..
How to cite this article: Krishna S, Panda S, Jha S, Negi N, Sahoo SN, Saha SC. Surgery First Orthognathic Approach: A Paradigm Shift in Orthognathic Treatment. Int J Drug Deliv Technol. 2026;16(33s):45-50. DOI: 10.25258/ijddt.16.33s.6

Source of support: Nil.
Conflict of interest: The author declares no conflict of interest, and this work represents independent academic research conducted in a personal capacity, not associated with any employer or commercial entity.

INTRODUCTION

Traditionally, orthognathic surgery has a three-step procedure; this includes pre-surgical orthodontic decadency [12-24 months] to resolve dental position, orthognathic surgery to resolve skeletal discrepancy, and post-surgical orthodontic refinement [another 6-12 months]. Although this traditional method is clinically effective, it requires a pre-surgical treatment period of 24-36 months and exposes the patient to the temporary facial aesthetics deterioration throughout the prolonged orthodontic pre-surgical period [1].

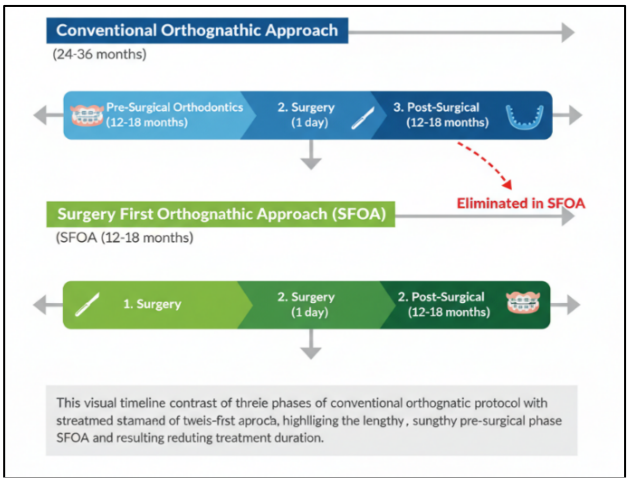

Figure 1: Comparison of Conventional vs. Surgery First Orthognathic Approach This figure provides a visual timeline contrasting the three phases of the conventional orthognathic treatment protocol—pre-surgical orthodontics, surgery, and post-surgical orthodontics—with the streamlined, two-phase surgery first approach. It highlights the elimination of the lengthy pre-surgical phase in SFOA and the resulting reduction in overall treatment duration.

First orthognathic approach [SFOA], initially introduced by Nagasaka et al. in 2009 is a fundamental challenge to this established paradigm in that it removes pre-surgical orthodontics and begins treatment with orthognathic surgery [2]. This novel protocol takes advantage of the regional acceleratory phenomenon [RAP] and is used to produce accelerated orthodontic movement [during the post-surgical period] which may decrease total treatment duration [by half] and has an instant aesthetic effect [3].

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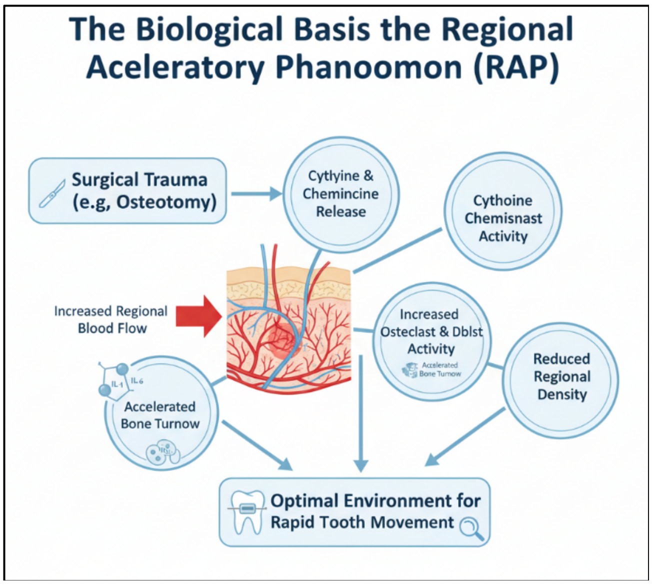

Figure 2: The Biological Basis of the Regional Acceleratory Phenomenon [RAP] This figure illustrates the cellular and molecular events of the regional acceleratory phenomenon [RAP]. It depicts the cascade of biological responses to surgical trauma, including increased blood flow, cytokine production, and accelerated bone turnover, which create an optimal environment for rapid orthodontic tooth movement.

The increasing patient interest in shorter treatment times and instant facial beautification, coupled with the innovations in the three dimensional virtual treatment planning, has created a lot of hype in SFOA among practitioners in the global world [4]. Nonetheless, implementation will be successful with the proper patient selection, advanced treatment planning skills, and comprehensive comprehension of the biological concepts that drive post-surgical tooth movement [5].

In this overall review, SFOA is explored in terms of existing evidence, the biological basis, clinical uses, comparative outcomes, and the future of the modern orthognathic surgery practice.

MATERIALS AND METHODS

Literature Search Strategy

The systematic search of the literature was done in PubMed, Scopus, and Cochrane Library databases that included publications since January 2009 and till December 2024. The search strategy used the following key terms: surgery first orthognathic approach, surgery first orthodontics, accelerated orthodontic movement, regional acceleratory phenomenon and immediate orthognathic surgery. Search terms were combined with Boolean operators [AND, OR] to expand the range of the useful literature.

Inclusion and Exclusion Criteria

The inclusion criteria included: [1] peer-reviewed articles, [2] clinical studies assessing the outcomes of SFOA, [3] comparative studies on SFOA versus conventional orthognathic treatment, [4] case series with 10 or more patients and [5] follow-up of 12 months. Entry criteria consisted of: [1] case reports had to contain at least 5 patients, [2] technical notes did not have any outcome data, [3], animal research, and [4] lack of English abstract..

Data Extraction and Analysis

Patient demographics, length of treatment, aesthetic results, occlusal stability, patient satisfaction scores, and complication rates were the areas of data extraction. The studies were classified in terms of the level of evidence and methodological quality. The study design and outcomes measures were heterogeneous, which led to the use of narrative synthesis instead of a meta-analysis method.

RESULTS

Treatment Duration and Efficiency

Various clinical trials always show that there is a marked decrease in total therapy time with SFOA in comparison to traditional regimens. The mean time of treatment of SFOA is 12-18 months compared to 24-36 months of conventional treatment, a 40-50 shift in the overall time of treatment [6]. The main efficiency gain of this technique is due to the lack of the pre-surgical orthodontic phase and the use of RAP-enhanced post-surgical tooth movement.

The rate of post-surgical orthodontic movements in SFOA patients exhibits an acceleration of 2-4 times than orthodontic movement and the highest efficiency is reached during the first 4-6 months after the surgery [7]. The time frame within which RAP can be maximally utilized is between 6 months and offer sufficient time in which a thorough orthodontic correction can be undertaken in a chosen case [8].

Aesthetic Outcomes and Patient Satisfaction

SFOA offers immediate beauty enhancement to the face after surgery, as the major concern of the patients with traditional treatment regimens. Investigations of standardized photography of faces and three-dimensional analysis of faces show results of equal or even better aesthetic effects of SFOA compared to conventional treatment [9]. Patient-reported outcome measures are always rated highly in terms of satisfaction levels during the treatment process, especially during the initial stages of treatment [10].

The sustainability of positive facial harmony and profile aesthetics of SFOA is demonstrated by long-term aesthetic evaluation studies with 2-5 years follow-ups [11]. The direct aesthetic advantage adds to the increase in patient compliance and cooperation during the post-surgical orthodontic period [12].

Occlusal Stability and Long-term Outcomes

Fears on the stability of occlusion after accelerated tooth movement in SFOA have been overcome in numerous longitudinal researches. Comparative analyses have shown similar occlusal stability in SFOA and conventional treatment at 2 years and 5 years follow-up assessments [13]. Cephalometric analyses indicate that there are stable skeletal relationships and positions of teeth in the event that proper retention measures are taken [14].

Similar scores were obtained in the evaluation of the American Board of Orthodontics Objective Grading System, which confirmed that there was no notable difference in final occlusal quality in the SFOA and conventional treatment groups, meaning that accelerated movement does not affect the quality of treatment [15].

Patient Selection and Predictability

Present evidence reports that about 20-40% of orthognathic patients qualify well in terms of their selection criteria of the SFOA. The ideal candidates are those patients who have: mild to moderate dental crowding or spacing, minimal vertical discrepancies, good skeletal relationships which can undergo post-surgical correction, and good periodontal health [16]. Patients who need extractions, patients whose dental compensations are severe, or those with a complicated vertical discrepancy will not be suitable to undergo SFOA with the existing protocols [17].

Three dimensional virtual planning of treatment has become a necessity to the success of SFOA because it allows the prediction of post-surgical tooth movement patterns and end-occlusal relationship with a great level of accuracy [18]. High-tech planning software enables modeling of the course of treatment and establishing any possible constraints prior to surgery [19].

Complications and Technical Challenges

When the proper patient selection criteria is used, reported complication rates with SFOA are similar to orthognathic treatment. The technical issues that are unique to SFOA are: the problems with bracket bonding based on post-surgical edema, the altered force systems necessitating the altered bone density, and the need to implement RAP at specific points to achieve maximum efficacy [20].

The most notable drawback is still the limited number of patients who can be taken through SFOA. Research shows that the increase in selection criteria without adequate protective measures can cause undermined results and prolonged treatment period [21].

DISCUSSION

Biological Foundations and Mechanisms

The regional acceleratory phenomenon is the basis of the success of SFOA as it is a well-documented biological reaction to surgical trauma that was initially described by Frost in 1983 [22]. RAP is characterized by a series of both cellular and molecular events such as augmented production of cytokines, augmented angiogenesis, stimulated bone turnover, and expedited tissue remodelling [23]. Such biological responses provide an ideal condition in which the orthodontic tooth movement can take place, and this is why there is a 2-4 fold rise in orthodontic tooth movement rates, which is seen in the clinic [24].

Recent studies have clarified the molecular pathways that are involved in RAP, which include bone morphogenetic proteins, transforming growth factor-b and systems of RANKL/ OPG [25]. The knowledge of these processes offers scientific basis of SFOA and indicates the possibility of improving and lengthening the RAP response [26].

Clinical Applications and Evolving Techniques

SFOA is in the process of further development due to the development of technologies and enhanced knowledge of post-surgical biology. Three-dimensional virtual treatment planning has become an inevitable part of providing proper results forecast and shortlisting of appropriate applicants [27]. Computers can be used to control surgical planning and make personal surgical guides through computer-aided design and manufacturing technologies [28].

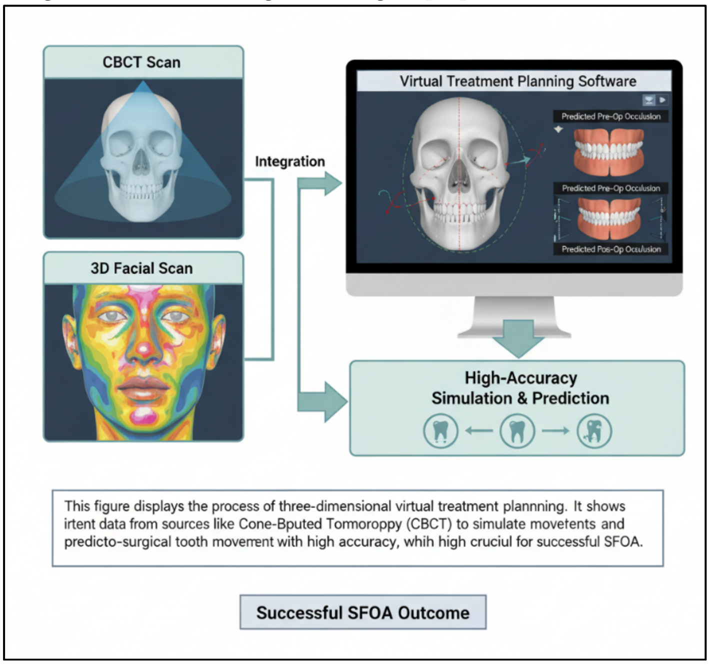

Figure 4: 3D Virtual Treatment Planning for SFOA This figure displays the process of three-dimensional virtual treatment planning. It shows the integration of patient data from sources like Cone-Beam Computed Tomography [CBCT] to simulate surgical movements and predict post-surgical tooth movement patterns with high accuracy, which is crucial for successful SFOA.

The use of temporary anchorage devices [TADs] in the SFOA procedures has increased the scope of treatment procedures and enhanced the management of tooth movement following surgery [29]. Intrasurgical placement of TADs offers improved anchorage of intricate orthodontic procedures with the RAP response being optimally utilized [30].

Comparative Analysis with Conventional Treatment

The direct comparisons of SFOA and the conventional orthognathic treatment indicate the clear benefits and limitations of each method. Although SFOA provides considerable time reduction and instant aesthetic benefits, the traditional treatment can be a better choice in complex conditions when the cases involve a considerable amount of dental preparation [31]. The decision to take either of the methods should be personalized according to the individual factors of the patient such as relationships with the dentist, the severity of skeletal discrepancy and the goals of treatment [32].

Economic benefits may be a possibility in the case of SFOA despite the increased planning expenses because of shorter treatment period and fewer visits [33]. Nevertheless, the need to have highly developed planning technologies and specific skills can restrict its use across certain clinical environments [34].

Future Directions and Innovations

New technologies have been on the rise to improve the predictability of SFOA and increase its uses. The use of artificial intelligence in treatment planning has potential benefits in terms of better patient selection algorithm and outcome prediction accuracy [35]. The use of advanced imaging methods such as dynamic cone-beam computed tomography offers improved imaging on the post-surgical tissue responses [36].

Scientific studies aimed at biological upgrading of RAP using pharmacological procedures, mechanical stimulation, or growth factor enrichment can also optimize the results of treatment [37]. Such studies have the potential to expand the biological window of accelerated movement and potentially increase the populations of suitable patients [38].

Clinical Implications for Practice

In the context of modern orthognathic surgery practice, SFOA is a potentially useful treatment method that needs the combination of developed surgical abilities, orthodontics competence, and technological proficiency. It requires interdisciplinary management involving oral surgeons and orthodontists, advanced virtual planning, and complete patient education on treatment expectation and restrictions to be successful [39].

The practice disrupts the existing paradigms of treatment and forces the practitioners to create new clinical guidelines and decision-making algorithms. With the improvement of technology and the increasing amount of evidence, SFOA applications are prone to further growth without losing sight of the best patient outcomes [40].

CONCLUSIONS

The surgery first orthognathic approach is a major breakthrough in orthognathic treatment and has a lot of positive impacts such as that it has a shorter treatment time, immediate esthetic result, and patient satisfaction among the strictly chosen candidates. The applicability and safety of this method is anchored in the biological context that is given by the phenomenon of regional accelerated by the fact that when applied with the right patient selection and holistic treatment planning, this approach has proved to be effective and safe.

The existing evidence shows that SFOA can provide the same level of long-term stability and clinical outcomes as conventional orthognathic treatment with major benefits in terms of treatment efficiency and patient experience. Nevertheless, it must be meticulously patient selected, provided with advanced virtual treatment planning facilities and organized multidisciplinary care to be successful.

The weaknesses of SFOA, especially in terms of limited suitability of patients and technical difficulty, stress the need to select cases correctly and have enough experience of the practitioner. With the further development of technology and better knowledge about post-surgical biology, the possibilities of SFOA usage and the focus on the best treatment outcomes will probably increase.

To propel the practice of orthognathic surgery in the future, SFOA offers an interesting treatment option that invites new paradigms without compromising the clinical excellence standard. Further development of research on the methods of biological enhancement, the development of new applications, and the increased predictability will contribute to further making SFOA an inseparable part of the modern orthognathic surgery.

Conflict of interest :

None

Acknowledgement:

No Funding.

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