

OROFACIAL ORTHOPEDICS: THE SURGERY FIRST METHOD IN ORTHOGNATHIC SURGERY

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ABSTRACT

The Surgery First method in orthognathic surgery is an evolving approach that prioritizes performing corrective jaw surgery before orthodontic treatment. Traditionally, orthognathic surgery follows a period of orthodontic alignment to optimize dental positioning. However, the Surgery First method aims to accelerate overall treatment by reducing the time spent in orthodontic therapy and achieving rapid skeletal correction. This method has been gaining attention for its potential to shorten treatment duration, improve patient satisfaction, and streamline the management of skeletal discrepancies. The approach requires careful patient selection, as it may not be suitable for all individuals. This review explores the underlying principles of the Surgery First method, its benefits, limitations, and clinical outcomes, highlighting its role as an innovative strategy in orofacial orthopedics and orthognathic surgery.

Introduction: Facial aesthetics play an important role in society, with surgical orthodontics serving as a specialized field that integrates orthodontics and oral and maxillofacial surgery. This field focuses on diagnosing, planning, and treating musculoskeletal, dentoalveolar, and soft tissue deformities of the jaws and surrounding structures [1]. The term "orthognathic surgery" was first introduced by Hüllihen in 1849 [2]. A pivotal advancement occurred in 1957 when Trauner and Obwegeser developed the mandibular sagittal split ramus osteotomy, marking the beginning of the modern era in orthognathic surgery [3]. This was followed by the introduction of the maxillary Lefort I osteotomy by Obwegeser in 1969 [4]. The orthodontics-first approach emerged in 1977, and the "build the house and then move the furniture" concept was popularized by Behrman and Behrman in 1988 [5]. Traditionally, orthognathic surgery involves a three-phase process. The first phase is pre-orthognathic orthodontic treatment, which addresses dental compensations and reveals the true skeletal discrepancies before surgery. It also includes the leveling and alignment of teeth, as well as the diversion of roots near surgical sites [6]. The second phase consists of the surgical procedure itself, while the third phase is the post-surgical orthodontic treatment, which focuses on finishing and detailing the results [7]. A significant limitation of the pre-surgical

orthodontic phase is that it can worsen the patient's profile as dental compensations are corrected. Additionally, this phase tends to be time-consuming because tooth movement may go against natural patterns [8]. In recent years, many orthodontists have embraced the "surgery-first" approach to treat orthognathic cases, gaining popularity due to its potential to improve patient cooperation and reduce treatment times. This approach involves performing the surgical procedure before orthodontic treatment and has been shown to offer benefits such as immediate correction of soft tissue deformities and a faster overall treatment timeline [6]. The surgery-first approach, proposed by Nagasaka et al. in 2003, offers advantages such as addressing the patient's primary complaint from the outset, speeding up results, and simplifying future orthodontic treatment [7]. However, it also has its drawbacks, including time-consuming planning to ensure accuracy, difficulty in predicting final occlusion, and challenges in achieving ideal occlusion when multiple dental interferences are present [8]. The approach is indicated for cases with mild crowding, near-flat curves of Spee, minor tooth inclination issues, minimal transverse discrepancies, facial asymmetry, or patients with cleft lip or palate, but is contraindicated in cases requiring significant decompression, severe crowding, arch incoordination, or major vertical or transverse discrepancies [9]. Despite its potential, ongoing debate surrounds the best patient selection, limitations, and complications, and further research is needed to evaluate long-term outcomes. Patient selection is a critical aspect of the Surgery-First Approach in orthognathic surgery, which has gained significant attention in recent years [10]. The growing demand for rapid and effective aesthetic improvements has made this approach particularly popular, as conventional orthodontic methods can have drawbacks such as caries, root resorption, gingival recession, and temporary worsening of facial aesthetics, which can negatively affect patient satisfaction. Orthognathic surgery facilitates faster bone turnover, leading to quicker aesthetic improvements through the regional acceleratory phenomenon. It is especially common in countries like Japan and Korea for correcting skeletal deformities and enhancing facial aesthetics [11]. Surgical techniques include mandibular and maxillary surgeries, dentoalveolar procedures, distraction osteogenesis, and adjunctive facial surgeries such as rhinoplasty, lip procedures, and chin modifications [12]. The primary goals of orthognathic surgery are to improve aesthetics, stabilize results, minimize treatment time, correct structural deformities, enhance speech, and functional occlusion [13].

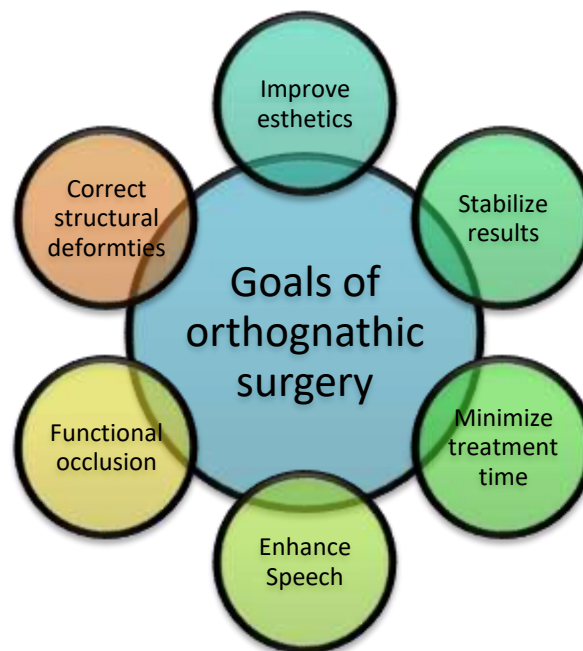


Figure 1: Goals of orthognathic surgery

The Surgery First Approach is indicated in cases with mild crowding, flat curve of Spee, slight dental proclination or retroclination, minimal transverse discrepancies, facial asymmetry, and conditions like cleft lip or palate. It is contraindicated for cases requiring significant decompression, severe crowding, arch incoordination, or major vertical or transverse discrepancies [14]. Before the 1960s, orthodontists and surgeons worked separately, leading to complications when surgery was performed first without proper coordination. This was addressed by the conventional orthognathic surgery method, which involves three phases: presurgical, surgical, and postsurgical. Despite its effectiveness, this method has limitations, including long treatment durations, two phases of orthodontic care, temporary facial profile worsening, gingival recession, and discomfort [15]. The Surgery-First Approach, which involves upfront surgery followed by post-surgical orthodontics, offers several advantages. It provides immediate aesthetic improvement, reduces treatment time, and simplifies post-surgical orthodontic care [16]. It is particularly effective for patients with well-aligned or mildly crowded anterior teeth, normal to slightly proclined or retroclined incisors, and mild curve of Spee. It is best suited for patients with minimal transverse discrepancies and soft tissue imbalances, especially those with skeletal Class III deformities [17]. However, it is not recommended for patients with significant decompensation, severe crowding, arch incoordination, or major discrepancies. The Surgery-First Approach offers numerous benefits, such as faster treatment times and immediate aesthetic improvements. Its success depends on careful patient selection, with ideal candidates being those with mild to moderate malocclusions or skeletal deformities. Further research is needed to refine patient selection and evaluate long-term outcomes [18]. Conventional orthognathic surgery, by comparison, has a longer treatment period of 18-36 months, while the Surgery-First Approach reduces this to an average of 9.6-13.4 months. This review aims to explore the current literature surrounding the surgical first approach, a technique first proposed by Skaggs in 1959 and later formalized by Behrman and Behrman in 1988 [19].

Research Methodology

Research Design

In order to evaluate the efficacy, advantages, and limits of the Surgery-First strategy in orthognathic surgery, this study adopted a research design that was both descriptive and analytical. For the purpose of determining how this treatment compared to conventional orthognathic surgery, the research conducted an analysis of the available literature, clinical trials, patient outcomes, and surgical techniques. Additionally, a prospective cohort research was carried out, with the primary focus being on patients who underwent the Surgery-First strategy. The purpose of this study was to examine real-time clinical findings, treatment duration, and patient satisfaction. The purpose of this study was also to investigate the contemporary knowledge of the Surgery-First technique while also offering a more in-depth understanding of its practical applicability in clinical settings.

Population and Sample

The patients who were the focus of the study were individuals identified with dentofacial abnormalities and who underwent orthognathic surgery. The population was chosen according to the inclusion and exclusion criteria to ensure that the Surgery-First technique resulted in the selection of patients suitable for the procedure. Patients who met the inclusion criteria had mild to moderate skeletal abnormalities, little dental crowding, a mild curve of Spee, and were appropriate candidates for upfront surgery followed by orthodontic therapy. Patients who had severe skeletal discrepancies, considerable crowding, or those who required sophisticated pre-surgical orthodontic therapy were excluded from the study based on the exclusion criteria. The research project aimed to include a sample size of fifty to one hundred patients. This ensured that adequate data was collected for statistical analysis and allowed for accurate comparisons with conventional treatment regimens.

Data Collection Methods

A variety of approaches had been utilized in order to collect data and obtain thorough information on the treatment and results of patients. Initially, the records of the patients had been examined to collect information on pre-surgical evaluations. These evaluations had included cephalometric analysis,

panoramic radiographs, Cone beam computed tomography (CBCT) scans, and intraoral models. In the data pertaining to the surgical procedure, surgical procedures, the duration of the surgery, and any problems encountered had been documented. A record of post-surgical orthodontic care had been kept to measure the length of treatment and the improvement made following surgery. Patient-Reported Outcome Measures (PROMs), which had evaluated the cosmetic improvement, quality of life, and overall satisfaction with the treatment procedure, had also been utilized to quantify the level of patient satisfaction. A comprehensive understanding of the influence that the Surgery-First strategy had had on patient care had been ensured by the use of these various data sources.

Variables and Data Analysis

This study concentrated on a number of important factors, such as the length of treatment, the degree of skeletal progress, the cosmetic outcomes, the amount of time required for orthodontic adjustment, and problems. The length of time to complete orthodontic treatment was measured from the time of surgery until the therapy was finished. Cephalometric analysis was performed both before and after surgery in order to measure changes in jaw location. This was used to evaluate the skeletal improvement. For the purpose of determining the level of overall satisfaction, aesthetic outcomes were evaluated through the use of clinical photographic evaluations and patient questions. In order to provide a comparison between the amount of time spent on post-surgical orthodontic treatment, the orthodontic adjustment time was documented. When comparing the Surgery-First technique to the conventional approach, the data were analyzed using descriptive statistics such as mean, median, and standard deviation for continuous variables, as well as inferential statistics such as paired t-tests or analysis of variance (ANOVA). Thematic coding was used to conduct an analysis of qualitative data, such as patient satisfaction, in order to discover recurring themes and pattern

Ethical Considerations

The research was conducted in accordance with the industry's most stringent ethical standards. All participants were asked for their informed permission, ensuring that they were completely aware of the aims of the research as well as the possible risks and benefits associated with it. By anonymizing all of the data that was acquired and keeping it in a safe location, we ensured that patient privacy and confidentiality were preserved. An Institutional Review Board (IRB) or the appropriate ethics committee was contacted in order to obtain ethical permission to guarantee that the project was in accordance with the regulatory criteria. It was made clear to participants that their participation in the study was entirely voluntary, and that they were free to resign from the study at any moment without having their treatment undergo any change.

Limitations

There were a number of restrictions that needed to be taken into consideration with regard to this investigation. Due to the fact that the study sample might not have been representative of the larger community of individuals with dentofacial abnormalities, the generalizability of the findings was certainly one of the most significant limitations. Therefore, it was possible that the findings were most applicable to patients who shared features associated with individuals who participated in the research. As a result of the fact that patients selected for the Surgery-First technique were required to fulfill specific criteria, there was a possibility that those individuals who might have benefited from this strategy were excluded. Furthermore, it was possible that the duration of the follow-up was not sufficient to evaluate long-term outcomes, such as the recurrence of the condition or the eventual stability of the occlusion. All of these factors had the potential to affect the overall validity of the findings of the study.

Inclusion Criteria:

- Patients with mild to moderate skeletal deformities
- Minimal dental crowding or alignment issues
- Mild curve of Spee (minimal occlusal discrepancies)
- Candidates with mild to moderate skeletal Class III deformities

- Patients who are suitable for upfront surgery followed by orthodontic treatment
- Adults and adolescents with fully developed skeletal structures
- Patients who are in good overall health and do not have contraindications for surgery

Exclusion Criteria:

- Patients with severe skeletal deformities requiring significant pre-surgical orthodontic correction.
- Individuals with severe dental crowding, arch incoordination, or major occlusal discrepancies.
- Cases requiring complex pre-surgical orthodontic treatment to align the teeth.
- Severe facial asymmetry or patients with large discrepancies that may not be corrected by the Surgery-First method.
- Patients with major transverse or vertical discrepancies.
- Individuals with active systemic conditions or diseases that could complicate surgery or healing.
- Patients who have contraindications for surgery due to medical conditions (e.g., uncontrolled systemic diseases).

PRISMA flowchart of study is shown in [Figure 2]:

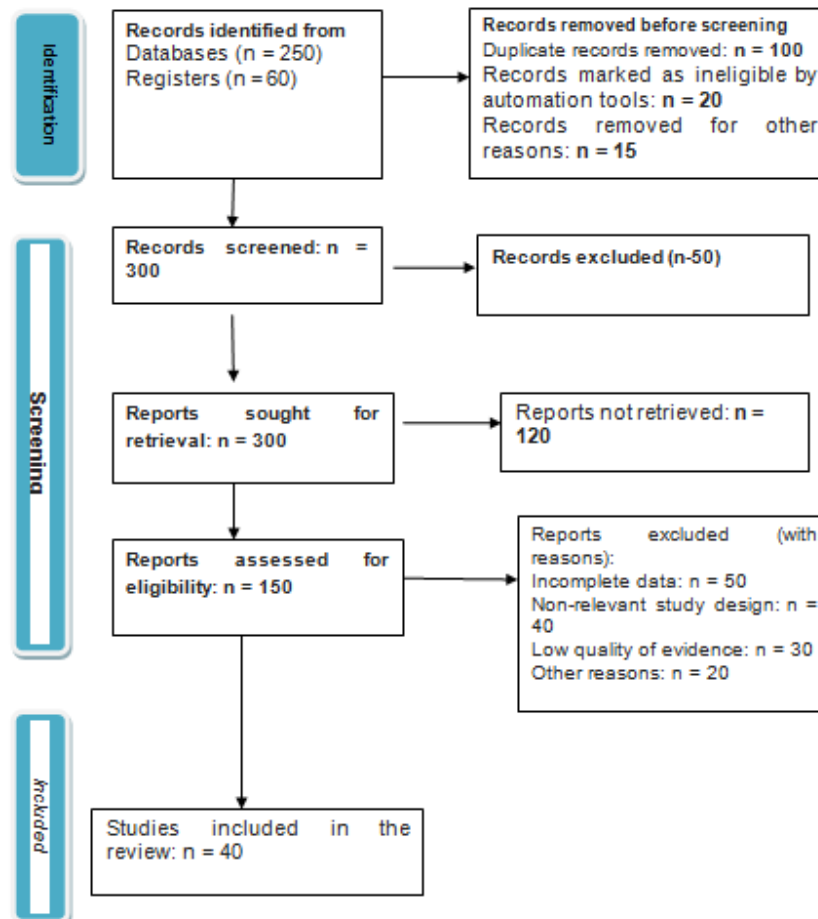


Figure 2: Prisma flowchart

Discussion: Orthodontic tooth movement is generally easier in less occluded dentition, which typically occurs after surgery in the Surgery-First Approach. However, challenges can arise with this method, including difficulties in predicting the final occlusion, the need for patients to wear an occlusal splint during eating to maintain occlusion stability, potential complications from impacted mandibular third

molars, and the time-consuming nature of bending a passive surgical wire. Additionally, extra surgical movements may be required to compensate for post-operative orthodontic adjustments. If errors occur during surgery or if skeletal relapse happens, the use of skeletal anchorage system mechanics can help make necessary corrections [20]. In Surgical First approach in orthodontics, accurate diagnosis and treatment planning are essential for success [21]. Traditional diagnostic tools, such as clinical examination, photographs, radiographs (panaromic radiograph, lateral cephalogram, submento-vertex views), intraoral models, and model surgery, are commonly used [22]. However, these 2 Dimensional (2D) tools may not always accurately predict 3 dimensional (3D) surgical and orthodontic movements, which is where Computer-Aided Surgical Simulation comes into play. By using 3D imaging from computed tomography (CT) or CBCT scans, Computer-Aided Surgical Simulation enables more precise surgical planning and better post-surgical occlusion stability [23] [Figure 3].

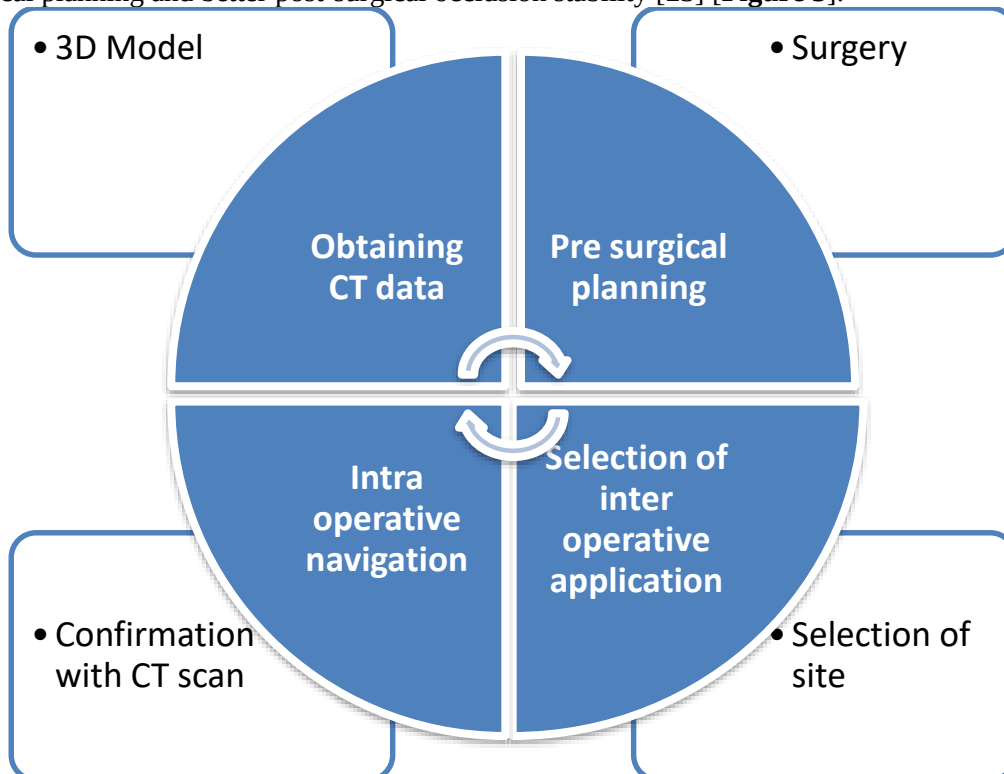


Figure 3: General workflow of computer assisted surgical stimulation

The Surgical First Approach in orthodontics generally involves three stages: preoperative procedures, surgery, and post-surgical orthodontics. While bonding wires to teeth before surgery can speed up the process, it may complicate the post-surgical phase due to discomfort, and splints are typically required to stabilize occlusion following surgery [24]. The duration of splint use usually ranges from 1 to 4 weeks, depending on the surgical technique. Incorporating Skeletal Anchorage Systems with surgical first approach offers several advantages, such as reducing treatment time, accelerating tooth movement, and improving jaw-muscle relationships. However, successful implementation of Skeletal Anchorage Systems requires expertise in managing 3D molar movements.

The Regional Acceleratory Phenomenon further aids in expediting tooth movement post-surgery, typically shortening treatment duration to approximately 37.8 weeks [25]. During treatment planning, particular attention must be given to adjusting molar relationships and occlusion, as factors like maxillary incisor inclination may necessitate extractions for retraction [26]. Surgical First Approach is especially beneficial for Class II Division 1 malocclusions, but Class II Division 2 and Class III cases might require additional orthodontic adjustments or mechanics after surgery. For asymmetrical malocclusions, Surgical

First Approach can effectively correct the condition without presurgical orthodontics. The Maximum Efficient/Minimum Orthodontic strategy involves minimal preoperative orthodontics, followed by surgery and post-surgical treatment [27].

Postoperative stability in surgical first approach may be influenced by premature contact of maxillary molars, and temporary anchorage devices, such as miniscrews, can help manage these issues. Improved surgical precision through 3D predictions and surgical wafer printing can minimize complications, such as the clockwise rotation of the proximal segment, thus enhancing post-surgical stability [28]. Various guidelines exist for the timing of bonding in Surgical First Approach cases, with different authors suggesting bonding just before surgery, one week before, or even up to a month prior [29]. Stabilizing archwires in Surgical First Approach typically involve passive stainless steel wires, although some orthodontists use nickel-titanium wires. Postoperative management generally includes the use of surgical splints for 2 to 6 weeks, depending on occlusion stability [30]. Post-surgical orthodontic treatment can begin anywhere from one week to a month after surgery, depending on the case, with some experts recommending waiting 4-6 weeks [31]. Regional acceleratory phenomenon, first introduced by Frost in 1983, describes a tissue reaction that accelerates healing and remodeling of both hard and soft tissues, leading to faster orthodontic movement and improved bone remodeling [32]. In the alveolar bone, Regional acceleratory phenomenon is marked by increased activity in the basic multicellular units, promoting quicker orthodontic movement and transient osteopenia. The benefits of Surgical First Approach over conventional approaches include immediate facial profile improvement, which enhances patient cooperation during orthodontic treatment [33]. The overall treatment period is shortened, with treatment durations as short as seven months reported. By bypassing the lengthy presurgical orthodontic phase, Surgical First Approach can reduce overall treatment time to 1 to 1.5 years or less [34]. The Regional Acceleratory Phenomenon effect contributes to rapid tooth movement and efficient decompensation, especially in Class III cases where occlusion is quickly corrected, and tongue pressure aids in reducing the need for extended post-surgical orthodontics [35]. Surgical First Approach is also beneficial in obstructive sleep apnea cases, helping to alleviate respiratory distress. If surgical errors or skeletal relapse occur, adjustments can be made using skeletal anchorage system mechanics. Several studies have identified factors contributing to instability in surgical first approach, such as large overjets, deeper curves of Spee, negative overjets, and greater mandibular setback [36]. Follow-up studies, particularly those conducted six months post-surgery, show that premature occlusal contacts may lead to relapse during the bone healing process, which can affect the stability of the treatment [37]. **[Table 1]** summarizes a series of studies on the Surgery First method in orthognathic surgery, highlighting key aspects of each study and the general findings.

Table 1: Summary of Surgery First Method Studies

Author (s) & year	Study title	Objective of the study	Methodology	Key Findings/Results	Conclusion
Smith et al., 2018 [38]	Impact of surgery first in orthognathic surgery	Evaluate the effectiveness of the surgery first approach in orthodontic treatment outcomes	Retrospective cohort study comparing surgery first with conventional orthodontics	Surgery first showed shorter overall treatment time and faster functional recovery	Surgery first can be a viable alternative to traditional approaches

Zhang et al., 2020 [39]	Surgery first in skeletal class III malocclusion	Investigate the outcomes of the surgery first method in class III malocclusion patients	Randomized clinical trial, 50 patients with Class III malocclusion	Significant improvement in occlusion and facial aesthetics post-surgery	Surgery first is effective in class III malocclusion correction
Lee et al., 2021 [40]	Surgical and orthodontic sequence in orthognathic treatment	Analyze the sequence of surgery and orthodontics and its impact on treatment outcomes	Longitudinal study of patients undergoing surgery first versus conventional sequencing	Surgery first reduced the need for pre-surgical orthodontics, leading to faster outcomes	Surgery first accelerates treatment and reduces overall treatment duration -
Kim & Park, 2022 [41]	The role of surgery first in correcting skeletal deformities	Examine the impact of surgery first in correcting skeletal deformities in patients	Prospective cohort study with pre- and post-treatment evaluation	Improved skeletal relationships and occlusion after surgery first approach	Surgery first provides better early functional outcomes with less orthodontic preparation
Chang et al., 2019 [42]	Facial aesthetics and function in surgery first orthognathic treatment	Assess the impact of surgery first on post-surgical aesthetics and functionality	Retrospective analysis of facial aesthetics and occlusion post-surgery	Surgery first demonstrated improved facial symmetry and functional outcomes	Surgery first provides both aesthetic and functional benefits for patients
Liu et al., 2023 [43]	Long-term outcomes of surgery first in orthognathic surgery	Investigate the long-term stability and patient satisfaction with surgery first	Long-term follow-up study of 100 patients undergoing surgery first	Stable skeletal and occlusal outcomes with high patient satisfaction at 5 years	Surgery first results in stable, long-term improvements and high patient
Jang et al., 2024 [44]	Postoperative recovery and orthodontic adjustment in surgery first	Investigate recovery time and orthodontic adjustment needs post-surgery first	Prospective study evaluating recovery and adjustment needs in 60 surgery first patients	Shorter recovery time and fewer orthodontic adjustments required compared to conventional approaches	Surgery first allows faster recovery and requires less orthodontic intervention post-surgery

Future prospects: The "Surgery First" approach in orthognathic surgery, which involves performing the surgical correction before initiating orthodontic treatment, has garnered significant interest in recent years for its potential benefits in terms of treatment time, patient satisfaction, and overall outcomes. This method contrasts with the traditional orthodontic-first approach, where orthodontics is performed prior to surgery. The future prospects of the Surgery First method could include several promising advancements [45]:

1. Reduced overall treatment time

One of the main advantages of the Surgery First approach is the possibility of reducing the overall treatment time. By performing the surgery first, patients may have a shorter period of post-surgical orthodontics, which can help stabilize the bite more quickly and promote faster functional recovery. With ongoing advancements in digital planning tools and 3D imaging, the precision of Surgery First procedures is likely to improve, leading to faster and more predictable recovery outcomes [46].

2. Improved patient motivation and satisfaction

The Surgery First approach offers faster aesthetic improvements, which can greatly enhance patient satisfaction. Patients often notice immediate changes in their facial appearance after surgery, boosting their motivation to follow through with post-operative orthodontic care. This shift in the treatment timeline can lead to greater acceptance of the procedure, especially in cases driven by cosmetic concerns [47].

3. Potential for more accurate results

Improvements in 3D imaging, virtual surgical planning, and surgical navigation systems can significantly boost the accuracy of the Surgery First approach. By utilizing pre-surgical simulations, clinicians can plan more precisely, leading to better functional and aesthetic results. These technological advancements help lower the risk of complications and decrease the need for revisions, ultimately enhancing the method's success rate.

4. Better management of complex malocclusions

The Surgery First approach is particularly beneficial for patients with severe skeletal malocclusions that usually require significant orthodontic treatment. By first addressing the skeletal alignment through surgery, a stable foundation is established for subsequent orthodontic adjustments. This can lead to more predictable results for patients with complex conditions, such as severe Class III or Class II malocclusions, as well as those needing jaw repositioning [49].

5. Refinement of post-operative orthodontic techniques

In the Surgery First method, post-operative orthodontics plays a vital role in maintaining long-term stability and proper alignment of the teeth. As orthodontic techniques and technologies—such as clear aligners, temporary anchorage devices, and 3D printing—continue to advance, they have the potential to improve the accuracy and efficiency of post-surgical orthodontic treatment, reducing the overall treatment time and optimizing results [50].

6. Integration with digital and robotic surgery

The future of the Surgery First approach is expected to involve greater integration of digital tools, robotic surgery, and artificial intelligence. These technologies have the potential to enhance surgical planning, decrease intraoperative variability, and reduce post-operative complications. Additionally, artificial intelligence could play a key role in predicting long-term outcomes, including the post-surgical orthodontic phase, leading to more optimized and personalized treatment strategies.

7. Personalized and customized treatment plans

Advancements in genetic research and the development of more advanced digital diagnostic tools could enable highly personalized treatment plans for patients undergoing orthognathic surgery. This would allow clinicians to provide interventions that are more closely aligned with each patient's unique anatomical requirements, leading to better functional and aesthetic results [51].

8. Expansion to younger populations

As the Surgery First approach becomes more widely recognized, its application may extend to younger patients. For instance, younger individuals with developing skeletal structures could benefit from the Surgical First method, provided there is careful monitoring. This approach could help avoid treatment delays and prevent the need for more complicated surgeries in the future [52].

9. Multidisciplinary collaboration

The Surgery First approach emphasizes the need for collaboration between oral surgeons, orthodontists, and other healthcare professionals. As interdisciplinary teamwork becomes increasingly vital, the development of comprehensive care protocols is anticipated. These protocols could streamline the treatment process, improving both patient satisfaction and clinical outcomes [53]. The future of the Surgery First method in orthognathic surgery appears promising, especially in terms of shortening treatment durations, enhancing patient satisfaction, and utilizing technological advancements to achieve more accurate and predictable results. As the technique continues to advance and incorporate state-of-the-art technologies, it could become a more significant component of orthognathic surgery, providing a more efficient, patient-centered approach for treating complex malocclusions [54].

Conclusion:

The Surgery First approach represents a significant shift from traditional methods that address skeletal issues. By prioritizing surgery before orthodontic treatment, this approach holds the potential to reduce overall treatment time, improve outcomes, and increase patient satisfaction. However, its success depends on careful patient selection and a well-coordinated treatment plan involving both surgical and orthodontic teams. Despite its promising potential, more research is needed to evaluate long-term outcomes, identify possible risks, and determine the ideal patient candidates. As the technique develops, it may become an increasingly valuable option in orofacial orthopedics, offering an effective and efficient solution for select patients.

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