Annali di Stomatologia
The Italian Journal of Odontostomatologic Sciences
Vol. 17 | No. 2 | 2026 | pp. 450-457 | eISSN 1971-1441 | ISSN 1824-0852

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Surgery-first orthognathic approach: a narrative review of clinical rationale, comparative outcomes, digital workflow, and practical limits

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Abstract

Background

Orthognathic surgery remains the reference treatment for severe dentofacial deformities when orthodontic treatment alone cannot restore skeletal harmony, facial balance, and stable occlusal function. The surgery-first approach reverses the conventional orthodontics-first sequence by performing skeletal correction before comprehensive orthodontic decompensation, aiming to reduce total treatment duration and provide immediate facial improvement. This narrative literature review synthesizes comparative evidence on treatment duration, skeletal stability, quality of life, digital workflow, practical limits, and patient selection. The evidence supports a clinically meaningful reduction in overall treatment time, generally without clear compromise of short- to medium-term stability in carefully selected cases. The strongest early advantages concern facial aesthetics, motivation, and oral health-related quality of life, whereas the main limitations involve occlusal instability, residual dentoalveolar compensation, relapse risk in complex patterns, and dependence on precise interdisciplinary planning.

Keywords: orthognathic surgery; surgery-first approach; skeletal Class III malocclusion; dentofacial deformity; quality of life; cone-beam computed tomography; virtual surgical planning; regional acceleratory phenomenon.

Article History

Received: May 11, 2026
Accepted: June 24, 2026
Published: June 30, 2026

DOI

https://doi.org/10.59987/ads/2026.2.450-457

Journal Info

eISSN 1971-1441 | ISSN 1824-0852
Scopus | DOAJ | Crossref
Peer Review: Double-anonymous

How to Cite

Lorenzo Silenzi Ederli, Elisabetta Carli, Elvira Liotti, Mario Palermiti, Beatrice Marzo, Stefano Mummolo.
Surgery-first orthognathic approach: a narrative review of clinical rationale, comparative outcomes, digital workflow, and practical limits.
Annali di Stomatologia. 2026;17(2):450-457.
doi: 10.59987/ads/2026.2.450-457

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Introduction

Orthognathic surgery is the reference treatment for severe dentofacial deformities when orthodontic tooth movement alone cannot restore skeletal harmony, facial balance, and stable occlusal function [1-3]. The conventional orthodontics-first sequence remains highly reliable because dental decompensation is completed before skeletal repositioning; however, it often involves long treatment times, a transient worsening of facial appearance, and reduced motivation during the presurgical phase [2-3].

The surgery-first approach (SFA) reverses the classic sequence by placing orthognathic surgery before comprehensive orthodontic decompensation. Historically, SFA emerged from carefully selected Class III protocols and from the observation that postoperative bone remodeling may accelerate orthodontic tooth movement in the early healing phase [4,8-10]. Its contemporary rationale is not only biological, but also psychological and organizational: the patient obtains immediate facial improvement, while the orthodontic phase is concentrated after skeletal correction [8-13].

The comparative literature has progressively expanded from case reports and single-center series to systematic reviews and meta-analyses. Current evidence indicates that SFA can reduce overall treatment duration, improve early oral health-related quality of life, and maintain acceptable short- to medium-term skeletal stability in selected patients [4-7,11-20]. Nevertheless, some reviews highlight a possible tendency toward less favorable stability in certain vertical or horizontal parameters, especially when decompensation is severe or when the predicted postoperative occlusion is unstable [7,16].

For this reason, SFA should not be interpreted as a simplified shortcut. It is a high-precision treatment philosophy requiring surgeon-orthodontist calibration, virtual occlusal set-up, CBCT-based diagnosis, three-dimensional surgical simulation, and close postoperative monitoring [14-16,40-51]. When these requirements are not met, the same features that make SFA attractive - rapid surgery and early aesthetic improvement - may increase the risk of occlusal instability or incomplete finishing [16,27-32].

Materials and Methods

Study design

This manuscript was designed as a narrative review of the literature focused on the surgery-first approach in orthognathic surgery. The review summarizes the clinical rationale, treatment duration, skeletal and occlusal stability, patient-reported outcomes, digital planning workflow, indications, contraindications, and practical limitations of this protocol.

Search strategy and eligibility framework

A bibliographic search was performed in PubMed/MEDLINE for articles published from January 2010 to August 2025. The following search terms and combinations were used: “surgery first”, “surgery-first approach”, “orthognathic surgery”, “SFA”, “skeletal Class III malocclusion”, “dentofacial deformity”, “quality of life”, “oral health-related quality of life”, “3D planning”, “virtual surgical planning”, “cone-beam computed tomography”, and “digital workflow”. Additional relevant articles were identified by screening the reference lists of selected publications.

Study selection and synthesis

Eligible publications included systematic reviews, meta-analyses, comparative clinical studies, retrospective and prospective cohort studies, and clinically relevant narrative reviews on surgery-first orthognathic treatment in human subjects. Priority was given to studies comparing the surgery-first approach with conventional orthodontics-first treatment and to studies reporting treatment duration, skeletal stability, occlusal outcomes, quality of life, or digital planning. Animal studies, cadaveric studies, articles unrelated to orthognathic surgery, case reports, very small case series without generalizable evidence, and papers without a clear description of the surgery-first protocol were excluded. Because of heterogeneity in study design, malocclusion type, surgical procedure, orthodontic mechanics, follow-up duration, and outcome measures, no statistical pooling was performed; the evidence was synthesized narratively by topic.

Results

Biological and technical rationale

The biological rationale for SFA relies in part on the regional acceleratory phenomenon (RAP), a transient increase in bone turnover and tissue remodeling following surgical injury [23-26]. Orthognathic osteotomies may therefore create a postoperative window during which orthodontic tooth movement is facilitated, especially during the first months after surgery [8,23-26]. This mechanism can help explain the shorter treatment times reported in many SFA cohorts, although it does not eliminate the need for controlled mechanics, stable anchorage, and careful finishing [11-16,23-26].

The technical challenge is that the jaws are repositioned before full orthodontic decompensation. Consequently, the surgeon and orthodontist must predict the final occlusion from arches that may still contain dental compensations, rotations, crowding, curve of Spee alterations, or transverse discrepancies [14-16,27-32]. This requirement makes virtual set-up, occlusal simulation, and postoperative orthodontic control central to the protocol [14-16,40-51].

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Comparative evidence on treatment duration

Shorter total treatment duration is the most consistent advantage of the surgery-first protocol. Comparative studies and reviews commonly report a reduction of several months compared with conventional care, largely because the presurgical orthodontic phase is eliminated or minimized [4-6,11-13,17-20]. In one frequently cited cohort, mean treatment time was approximately 14.6 months in SFA patients compared with 22.0 months in orthodontics-first patients [11]. Other cohorts and reviews support a similar direction of effect, although the magnitude varies according to extraction pattern, severity of compensation, surgical movement, and finishing goals [12-13,17-20].

This reduction should be interpreted clinically rather than simplistically. A shorter total duration does not necessarily mean a less demanding treatment. The postoperative orthodontic phase is often intensive, and the clinician must rapidly coordinate alignment, arch coordination, torque control, settling, and retention while the patient is still adapting to the new skeletal and soft-tissue balance [14-16,27-32].

Skeletal stability and relapse risk

The available evidence suggests that short- to medium-term skeletal stability can be broadly comparable between SFA and conventional treatment in selected patients [5-7,17-20]. However, some analyses caution against surgery-first or early-surgery protocols, particularly for mandibular setback, vertical control, open-bite tendency, and cases with residual dental compensation [7,27-32]. Stability is therefore not determined by treatment sequence alone; it is the result of correct indication, muscular adaptation, condylar seating, fixation, occlusal settling, and retention strategy [27-32].

From a practical point of view, patients with limited dental compensation, acceptable anticipated postoperative intercuspation, minimal transverse discrepancy, and high compliance are more favorable candidates for SFA. Conversely, severe crowding, marked arch asymmetry, open bite with vertical instability, extensive incisor compensation, or poor capacity for postoperative follow-up may favor a conventional orthodontics-first sequence [7,16,27-32].

Aesthetic and patient-reported outcomes

The main patient-centered benefit of SFA is immediate improvement in facial appearance after surgery. In conventional care, presurgical decompensation can temporarily worsen the profile, especially in Class III or Class II deformities, whereas SFA moves the aesthetic turning point to the beginning of treatment [17-20,33-39]. This earlier improvement can reduce treatment fatigue and may increase motivation for the postoperative orthodontic phase [17-20,33-39].

Quality-of-life studies using instruments such as the Orthognathic Quality of Life Questionnaire (OQLQ) and the Oral Health Impact Profile (OHIP-14) generally show a more favorable early trajectory in SFA patients [17-22,33-39]. The advantage is strongest in the early postoperative months, especially in facial aesthetics, social confidence, and psychological domains. By final follow-up, differences between SFA and conventional protocols may diminish because both approaches aim for similar skeletal, occlusal, and aesthetic endpoints [17-20,33-39].

Digital workflow

Digital technology is not merely an accessory in surgery-first treatment. It is an enabling condition for safe execution. CBCT, intraoral scanning, digital dental casts, virtual occlusal set-up, three-dimensional surgical simulation, CAD/CAM splints, customized cutting guides, and patient-specific plates help reduce uncertainty when the presurgical occlusion is not fully decompensated [14-16,40-51].

Virtual planning permits evaluation of the maxilla, mandible, dentition, condyles, occlusal plane, airway, and soft-tissue prediction in a single coordinated environment [40-47]. Recent systematic reviews indicate that digital planning can improve reproducibility and transfer accuracy. However, it still depends on segmentation quality, registration accuracy, surgical execution, and adequate postoperative comparison between planned and achieved movements [46-47,51].

Artificial intelligence is increasingly being studied for segmentation, landmark identification, prediction of soft-tissue response, and decision support [48]. These tools may eventually improve speed and standardization, but current evidence does not justify replacing specialist judgment. In SFA, AI should be considered a planning aid rather than an autonomous decision-maker [48].

Complications and practical limits

The reviewed evidence did not identify a consistent increase in general surgical morbidity in SFA compared with conventional treatment. The most important risks are instead orthodontic and occlusal: unstable early contacts, difficult settling, need for intensive mechanics, and possible mismatch between virtual prediction and biological adaptation [7,16,27-32]. These problems may compromise the finishing if the team underestimates dental compensation or if postoperative appointments are insufficiently frequent.

The protocol is therefore most suitable for centers with experience in orthognathic planning, digital workflow, and close interdisciplinary communication. The decision should consider malocclusion pattern, skeletal movement, soft-tissue goals, airway, temporomandibular status, periodontal limits, oral hygiene, compliance, and the patient's ability to attend frequent postoperative

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visits [27-32,40-51].

The core clinical differences between the surgery-first approach and the conventional orthodontics-first protocol are summarized in Table 1.

Table 1. Core comparative profile of surgery-first and conventional orthognathic treatment.

Domain	Surgery-first approach	Conventional orthodontics-first protocol
Treatment sequence	Surgery followed by orthodontic finishing	Presurgical orthodontics followed by surgery and finishing
Treatment duration	Generally shorter when selection is appropriate	Usually longer because of presurgical decompensation
Early facial aesthetics	Immediate improvement after surgery	May worsen temporarily before surgery
Patient motivation	Often improved early because facial change is immediate	May decline during lengthy presurgical phase
Occlusal management	More demanding immediately after surgery	More predictable at the time of surgery
Digital dependence	High reliance on CBCT, virtual set-up, simulation, and CAD/CAM transfer	Digital tools are useful, but presurgical decompensation provides a larger occlusal safety margin
Best indications	Selected cases with limited compensation and predictable postoperative occlusion	Broader applicability, including complex compensation patterns

The main evidence domains identified across the reviewed literature are summarized in Table 2.

Table 2. Evidence domains were synthesized from the reviewed literature.

Outcome domain	Main signal from the literature	Clinical interpretation
Treatment time	SFA usually shortens overall treatment duration	Most reproducible advantage
Stability	Often comparable in selected cases, with caution in vertical/open bite or severe compensation patterns	Acceptable when indication and planning are strict
Early aesthetics	Favors SFA because surgery precedes decompensation	Major driver of patient acceptance
Quality of life	Earlier improvement in OQLQ/OHIP-14 domains	Advantage often decreases by final follow-up
Complications	No clear increase in general surgical morbidity	Main risks are occlusal and orthodontic
Technology	CBCT, virtual planning, CAD/CAM transfer, and AI tools improve prediction	Digital workflow is central to safe SFA

Discussion

The central message of the updated literature is that SFA is not merely an inversion of the treatment order. It is a planning-intensive protocol that shifts much of the complexity from the presurgical orthodontic phase to the diagnostic, simulation, and postoperative control phases [14-16,40-51]. This explains why the protocol can be efficient and motivating in favorable Class III malocclusions, but less forgiving in severe compensation, open bite, or complex asymmetry [7,16,27-32].

From a clinical perspective, the success of the surgery-first approach depends on the ability to anticipate the final occlusion before complete orthodontic decompensation. This makes case selection decisive: patients with limited dental compensation, manageable transverse discrepancy, and a predictable postoperative occlusal relationship are more suitable candidates, whereas severe crowding, marked asymmetry, vertical instability, open bite tendency, or poor compliance may require a conventional orthodontics-first sequence.

Beyond sequence-related outcomes, surgery-first treatment should be interpreted within a multidisciplinary framework that includes skeletal diagnosis, occlusal planning, periodontal limits, functional assessment, airway considerations, temporomandibular status, and patient compliance.

From a scientific perspective, the main limitation of the SFA literature remains heterogeneity. Studies differ in malocclusion type, surgical movement, use of extractions, fixation, digital planning, orthodontic mechanics, retention protocol, and follow-up duration [4-7,11-20]. Many studies are retrospective, and randomized trials remain scarce. For this reason, claims of superiority should

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be limited to specific domains, such as shorter treatment time and early quality-of-life improvement, rather than generalized to all outcomes [17-20,33-39].

Future research should prioritize prospective comparative cohort studies, standardized inclusion criteria, longer follow-up periods, explicit relapse metrics, shared digital planning protocols, and validated patient-reported outcome measures. Further studies should also clarify cost-effectiveness and the clinical impact of virtual surgical planning, CAD/CAM transfer, and artificial intelligence-assisted tools within strictly defined surgery-first protocols [17-22,33-51].

Conclusions

The surgery-first orthognathic approach is a credible and increasingly mature alternative to the conventional orthodontics-first sequence in selected patients with dentofacial deformity.

Its most consistent advantages are shorter overall treatment duration, immediate facial improvement, and a more favorable early quality-of-life profile.

These benefits are counterbalanced by greater planning complexity, higher dependence on digital workflow, and more demanding early occlusal management.

Current evidence suggests that short- to medium-term skeletal stability can be comparable to that of conventional treatment when selection, virtual planning, surgical execution, and postoperative orthodontic control are rigorous.

Author Contributions

Conceptualization, Lorenzo Silenzi Ederli; methodology, Elvira Liotti; validation, Elisabetta Carli; investigation, Stefano Mummolo; data curation, Beatrice Marzo; writing - original draft preparation, Mario Palermiti; writing - review and editing, Lorenzo Silenzi Ederli; supervision, Stefano Mummolo. All authors have read and agreed to the submitted version of the manuscript.

Funding

The authors declare that no external funding was received for this study.

Institutional Review Board Statement

Not applicable. This article is a literature review and does not include individual patient data, clinical images, or interventions on human participants.

Informed Consent Statement

Not applicable. This review does not present patient-level data, clinical photographs, radiographs, or identifiable clinical information.

Data Availability Statement

No new data were generated or analyzed in this review. All information discussed is available in the cited publications.

Conflicts of Interest

The authors declare no conflict of interest.

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