



Main considerations in orthognathic and aesthetic surgery: a systematic review

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Abstract

Introduction: Orthognathic surgery (OS) is an important tool for correcting facial deformities. Autologous fat injection enables precise contouring and volumization in conjunction with OS to optimize aesthetics. **Objective:** To present key considerations regarding orthognathic surgery and aesthetics. **Methods:** The study followed PRISMA guidelines for systematic reviews and AMSTAR 2 criteria for methodological quality. Searches were conducted between May and July 2026 across the Web of Science, Scopus, PubMed, LILACS, EBSCO, SciELO, and Google Scholar databases. Study quality was assessed using the GRADE tool, and risk of bias was analyzed using the Cochrane tool. **Results and Conclusion:** A total of 137 articles were identified. Fifty-seven articles were evaluated in full, with 36 included and analyzed in this systematic review. Clinical studies showed homogeneity in their results, with a Chi-square (X^2) value of 71.6% (>50%). Regarding the Cochrane risk-of-bias tool, the overall assessment identified 15 studies with a high risk of bias and 20 studies that failed to meet GRADE and AMSTAR-2 criteria. According to the Cochrane tool, the risks of bias did not compromise scientific progress. It was concluded that volume augmentation with adipose tissue can be a viable intervention for mild to moderate facial deficiency following orthognathic surgery. Most studies analyzed in this review demonstrated that fat grafting in orthognathic surgery is a safe and effective tool for improving healing and aesthetic outcomes, as well as for providing anti-inflammatory effects and reducing edema.

Keywords: Orthognathic surgery. Lipografting. Aesthetics.

Introduction

Orthognathic surgery (OS) aims to correct deformities of the maxillary and mandibular bones [1-3]. In this context, facial deformity has a negative impact, resulting in social and psychological disadvantages. The technique has undergone significant evolution over the last two decades and continues to grow in use. Facial growth patterns are a primary etiological factor in malocclusion [4-8]. Facial deformity, with its potential for destructive psychological and social effects, negatively impacts patients, leading to social and psychological disadvantages. Thus, patients with dentofacial deformities also have psychosocial goals, seeking to resolve these issues by improving their appearance through surgical correction [9-14].

Accordingly, OS is performed on patients with moderate to severe dentofacial deformities, with the primary objective of achieving functional balance and facial aesthetic harmony [15]. Patients with anatomical abnormalities contributing to the narrowing or obstruction of the pharyngeal airway during sleep benefit from orthognathic surgery, which normalizes facial soft and hard tissues [16]. Thus, OS addresses moderate to severe facial deformities [17].

In this scenario, fat grafting serves as a powerful tool for correction and facial aesthetic enhancement, either concurrently with or following OS. The evolution of this technique is fascinating and has been extensively described [12]. Currently, general procedural practice standards are derived from the work of Sydney Coleman [14-18]. Fat grafting during orthognathic surgery offers benefits such as maximizing aesthetic outcomes, minimizing edema, and optimizing wound healing [1,2].

Coleman advocates for the atraumatic harvesting and injection of adipose tissue, thereby preserving the lipoarchitecture. Such meticulous attention to technique allows for a better assessment of the grafted fat. The senior author implements these well-defined parameters for facial fat grafting in his practice. The authors state that autologous adipose tissue transplantation can be considered safe. The only study with the appropriate design, follow-up, and sample size to evaluate the safety of facial fat grafting reported an infection rate of 4.8% and an overall complication rate of 13.6% [14,15]. A Cochrane systematic review suggested an expected infection rate of less than 2% in liposuction surgery [19].

Given this, this study aimed to present the main considerations regarding orthognathic surgery and aesthetics.

Methods

Study Design and Data Analysis

This study followed an international systematic review model, adhering to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [20]. Available at: <http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1>. Accessed on: May 15, 2026. Methodological quality standards from AMSTAR 2 (Assessing the Methodological Quality of Systematic Reviews) were also followed. Available at: <https://amstar.ca/>. Accessed on: May 20, 2026. To analyze the results from the articles included in the statistical analysis, the Chi-square (χ^2) test was performed to determine the homogeneity or heterogeneity of the studies regarding the safety and success of adipose tissue grafting following orthognathic surgery [21].

Data Sources and Search Strategy

Search strategies for this brief systematic review were based on the following keywords (DeCS/MeSH terms): "*Orthognathic surgery. Lipografting. Aesthetics*". The search was conducted from May to July 2026 across the Web of Science, Scopus, PubMed, LILACS, EBSCO, SciELO, and Google Scholar databases, covering both English and Portuguese languages. Additionally, a combination of keywords with the Boolean operators "OR," "AND," and "NOT" was used to target relevant scientific articles.

Study Quality, Eligibility Criteria, and Risk of Bias

Studies were selected if they rigorously reported the results of the search process, demonstrated scientific quality according to the GRADE classification [22], and presented no significant risk of bias—that is, no bias that could compromise the reliability of the

results. In accordance with GRADE recommendations, the quality of scientific evidence in the studies reviewed was classified as high, moderate, low, or very low, based on the risk of bias, sample size, clarity of comparisons, precision, and consistency of effects across analyses. High-quality evidence was assigned based on the following criteria: 1) Randomized clinical trials or prospective controlled trials; 2) Retrospective clinical trials or case series; 3) Sample size exceeding 15 participants; 4) Studies with robust statistical results; 5) Studies published in indexed journals with a significant impact factor; and 6) Descriptive, interpretive, and theoretical validity (methodological credibility) as well as pragmatic validity.

Results and Discussion

Summary of Literature Findings

A total of 137 articles were identified. Duplicate articles were initially excluded. Following this, abstracts were evaluated, and further exclusions were made to remove articles that did not address the study's topic or failed to meet the methodological quality criteria established by AMSTAR 2, resulting in 92 articles. A total of 57 articles were evaluated in full, and 36 were included and analyzed in this systematic review (Figure 1). Of the 18 articles listed in the references, 6 appear only in the introduction. The clinical studies showed homogeneity in their results, with a Chi-square (χ^2) value of 71.6% (>50%). Based on the Cochrane risk-of-bias tool, the overall assessment identified 15 studies with a high risk of bias and 20 studies that failed to meet GRADE and AMSTAR-2 criteria.

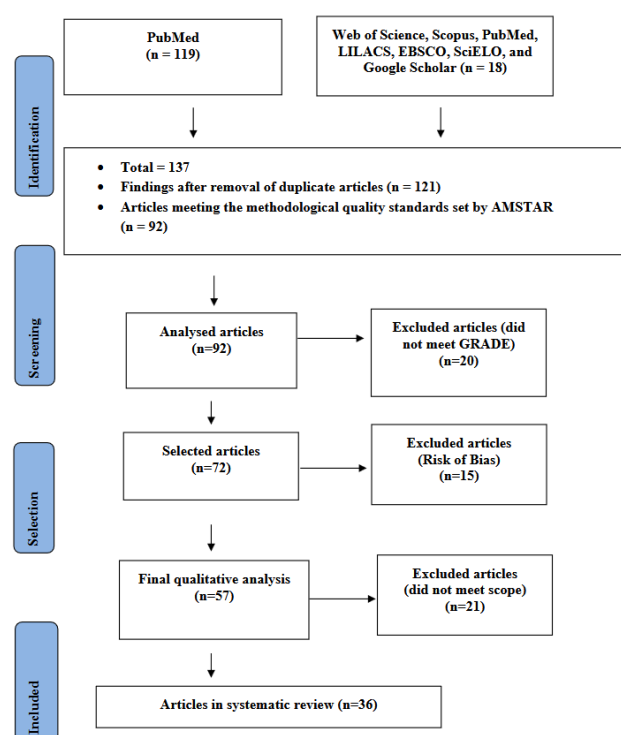


Figure 1. Article selection process. Source: Own authorship.

Main Clinical Findings (n=36 clinical studies)

Orthognathic surgery (OS) aims to establish harmonious facial aesthetics, optimal functional occlusion, and improved airway conditions [12,23]. The high prevalence of maxillomandibular deformities and the large number of combined maxillary and mandibular surgeries appear to demonstrate the severity of the treated dentofacial deformities [24-26]. Individuals with Class III dentofacial deformities typically experience the greatest aesthetic and functional impact; consequently, they are the ones most likely to seek treatment [27]. Furthermore, more extensive surgical procedures generally carry a higher risk of complications and involve more significant healing and recovery processes [26,27].

In this context, and serving as an important adjunct to OS, fat grafting is becoming increasingly common due to its anti-inflammatory role and its effect on increasing facial volume. Study results showed that an average of 13.1 cc of fat—harvested from the lower abdomen or medial thigh—was injected into the patients' facial regions; none of the patients experienced local complications or wound healing issues, and all reported high satisfaction with the results [12].

Adequate fat volume can be efficiently harvested from most patients across a wide BMI range using the previously described atraumatic and cost-effective techniques. Fat grafting following OS is important for mitigating edema, as swelling can hinder recovery [28-30]. Accordingly, one study analyzed the use of fat grafting—using fat aspirated from the medial thigh or lower abdomen via a Coleman cannula and a 10cc syringe—in a retrospective cohort comparing patients who received fat grafts with those who did not, all of whom underwent bilateral Le Fort I and sagittal split osteotomies [28,29]. Postoperative swelling resolved by week 12 in the fat-grafting group, compared to persistent edema of 10.2% in the control group. Paracrine anti-inflammatory factors may contribute to these clinical outcomes [31].

Another publication by the same group examined the use of fat grafting in a cohort of rhinoplasty patients to mitigate postoperative edema [32], with follow-up extending to one year. This cohort of 40 patients provided quantitative evidence predicting a decrease in edema over time, with near-complete resolution by the one-year mark.

Other centers have reported similar results with fat grafting in patients undergoing orthognathic surgery, noting improvements in final aesthetic outcomes and patient satisfaction [33,34]. Significant results regarding fat grafting for cleft lip repair have also been reported in the literature [35,36]. Clauser et al. (4 studies of same author) [37-40] documented the aesthetic and

functional benefits of facial fat grafting in patients who underwent orthognathic surgery or reconstruction for facial trauma, facial burns, or congenital conditions (cleft lip/Treacher Collins syndrome), observing improvements in facial morphology, function, and skin quality and texture in the majority of their patients.

It is important to note that not all fat grafts are alike; a balance must be struck between time efficiency and procedural efficacy [41,42]. Emerging data on adipose biology suggest there may be an optimal fat lobule size to maximize graft retention; the trade-off between preserving stromal vascular fraction elements in smaller grafts and the risk of impaired diffusion and central necrosis in larger grafts warrants further study. Other authors advocate for the use of cell-assisted lipotransfer involving adipose-derived mesenchymal stem cells [43].

Other studies show that enriching fat grafts with autologous adipose-derived stem cells improves graft adherence and volume 121 days after implantation, as confirmed by magnetic resonance imaging [44]. In this context, it is worth noting that processed lipoaspirate from the lower abdomen and inner thigh may contain higher concentrations of adult mesenchymal stem cells [45].

Accordingly, the best facial aesthetic results leverage the regenerative potential of adipose-derived stem cells. Studies indicate the presence of approximately 35% to 40% adipose-derived stem cells per gram of fat [12]. In adipose lipoaspirate, these stem cells are mixed with various other cell types, including pericytes, fibroblasts, endothelial cells, and pre-adipocytes, as part of the stromal vascular fraction [46]. Coleman has written extensively on the benefits of fat grafting, including improved skin quality, softening of wrinkles and pore size, reduction of pigmentation, and scar resolution [47, 48]. Additionally, literature reviews have shown that enriching lipoaspirate with autologous adipose-derived stem cells increases graft retention [49,50].

In this scenario, it is important to emphasize the need for a precise volumetric assessment of the skull and soft tissues prior to orthognathic surgery. When selecting a surgical strategy, the surgeon must consider not only traditional osteotomies but also soft-tissue enhancement procedures, such as lipofilling. Preoperative surgical planning systems, such as virtual surgical planning protocols, rely primarily on predicting skeletal movement. Thus, a study described a new volumetric analysis process based on computed tomography (CT) to quantify autologous adipose tissue injected into patients undergoing simultaneous orthognathic surgery and lipofilling. Sixteen female patients were included in the study (mean age: 24.5

years). The mean difference between the injected adipose tissue and the amount quantified postoperatively was 6.01 cm³. All patients exhibited clinically satisfactory facial convexity, with complete restoration of cheek contour, at the 3-month mark [51].

A retrospective cohort study using three-dimensional (3D) imaging evaluated the effect of lipografting on postoperative edema following orthognathic surgery, while also considering the impact of age and BMI. A total of 130 postoperative 3D images from 31 patients were analyzed. A linear mixed model demonstrated that injected fat, age, and BMI are significant factors influencing postoperative volume. Age and BMI increased postoperative edema by 3.63 cm³ per year and 14.60 cm³ per kg/m², respectively. Injected fat reduced postoperative edema by 8.72 cm³ per 1 cc injected, accelerating the return to a steady state [52].

Also, a retrospective cohort study analyzed the effects of lipografting on facial edema (magnitude, duration, and rate of reduction) following orthognathic surgery. One hundred and sixteen sets of pre- and postoperative 3D photographic data were included. The sample consisted of 29 subjects. Facial volume was analyzed both overall and by comparing subgroups (orthognathic surgery alone vs. orthognathic surgery plus lipografting). The mean increase in postoperative facial volume was 23.7% for the entire cohort. At week 12, swelling had decreased by approximately 62% from baseline. Across all patients, there was a significant decrease in facial volume over time. In the fat grafting group—despite the addition of volume—facial volume was comparable to that of the non-fat grafting group at week 1, but the rate of reduction was faster up to week 12 [53].

The authors evaluated the effect of combining orthognathic surgery with autologous fat transfer in treating patients with facial asymmetry through a retrospective study. A total of 15 consecutive adults underwent combined orthognathic surgery and autologous fat transfer. Facial symmetry improved significantly with the combination of orthognathic surgery and autologous fat injection. Therefore, the combined use of orthognathic surgery and autologous fat transfer is a promising technique for improving facial symmetry in patients [54].

A systematic review evaluated the efficacy of autologous fat grafting on skin quality. The outcomes of interest were skin texture, color, and elasticity, as well as histological outcomes and the number of complications. Nine studies were included, involving a total of 301 treated patients. Eight studies reported increased skin elasticity, improved skin texture, and more homogeneous skin color following treatment with

fat grafting, stromal vascular fraction, or nanofat. Histological improvement was observed after fat grafting and injections of adipose-derived stromal cells. No serious complications were reported [55].

In another retrospective cohort study, authors described a series of consecutive patients who underwent orthognathic surgery with fat grafting. A total of fifty-three patients who underwent orthognathic surgery with concomitant fat grafting were reviewed. The cohort consisted of 20 men (37.7%) and 33 women (62.3%). Thirty-three patients (62.3%) underwent Le Fort I operations combined with genioplasty and/or bilateral sagittal split osteotomies. Twenty-eight patients (52.8%) underwent secondary operations involving additional fat grafting. The majority of these patients (15/28, 53.6%) received additional fat grafting during rhinoplasty. There were no complications at the donor site. The mean volume of injected fat was 13.1 cc (range: 5–25 cc). Follow-up lasted one year. Consequently, benefits regarding wound healing, improved aesthetic outcomes, and an anti-inflammatory effect were observed [12].

Parry-Romberg syndrome (PRS) is a rare neurocutaneous and craniofacial disorder characterized by progressive hemifacial atrophy and wasting; it predominantly affects children and young adults, with an estimated prevalence of 1 in 700,000 individuals. Despite its rarity, PRS poses significant challenges for patients, their families, and healthcare professionals due to its unpredictable course and potential functional and aesthetic impairments. One study provided a comprehensive overview of PRS, covering its clinical features, pathogenesis, and treatment techniques. A case of PRS was presented involving a 9-year-old girl with pronounced facial asymmetry, featuring marked wasting and atrophy across the entire right side of the face. Computed tomography revealed hypoplasia of the right maxilla, mandible, and zygomatic arch, along with enophthalmos of the right eye. Magnetic resonance imaging showed atrophy of the right temporalis, medial and lateral pterygoid, masseter, risorius, buccinator, zygomaticus major and minor, *levator labii superioris*, *levator anguli oris*, and *orbicularis oris* muscles. The clinical presentation of PRS typically involves progressive facial atrophy, predominantly affecting subcutaneous tissues, muscles, and bone. Patients may exhibit various symptoms as the condition progresses, including facial asymmetry, hemifacial pain, dental and ocular abnormalities, and neurological manifestations. The exact etiology of PRS remains unknown, although autoimmune, genetic, and vascular factors are likely contributors. Treating PRS requires a multidisciplinary approach involving dermatologists, plastic surgeons, neurologists, ophthalmologists, and dental specialists.

Treatment options aim to alleviate symptoms, improve function, and address aesthetic concerns. Surgical interventions—such as autologous fat grafting, facial reconstructive procedures, and orthognathic surgery—have restored facial symmetry and function. Furthermore, non-surgical modalities, including botulinum toxin injections, prosthetic devices, and dental interventions, can offer symptomatic relief and improve overall quality of life [56].

Finally, a randomized controlled clinical trial conducted by Helmy et al. (2024) [57] evaluated soft-tissue profile changes using autologous adipose tissue augmentation or PEEK onlay versus sliding genioplasty for the correction of chin deficiency in patients with a retruded chin. A total of 33 patients with chin deficiency were included in the study. Patients were assigned to three groups: the fat augmentation group (Intervention I), the PEEK augmentation group (Intervention II), and the bony genioplasty group (control). Pre- and postoperative CBCT scans were performed for all patients. Diagnosis, virtual planning, and assessment were carried out using MIMICS, 3-MATIC, and PROPLAN software. The FACE-Q questionnaire was used to assess patient satisfaction. There was a statistically significant difference regarding soft-tissue relapse in the fat group after 6 months compared to the control group (mean difference = 0.770), whereas there was no statistically significant difference regarding soft-tissue relapse between the PEEK group and the control group (mean difference = -0.060). Intra-group comparison showed no statistically significant difference regarding soft-tissue relapse across follow-up periods in any of the groups ($p = 0.1389$ for the fat group, $p = 0.8739$ for the PEEK group, and $p = 0.8410$ for the control group). All patients showed a statistically significant increase in chin satisfaction scores between follow-up periods.

Conclusion

It was concluded that adipose tissue augmentation may be a suitable intervention for cases of mild to moderate facial deficiency following orthognathic surgery. The majority of studies analyzed in this review showed that fat grafting in orthognathic surgery is a safe and effective tool for improving wound healing and aesthetic outcomes, as well as for providing anti-inflammatory effects and reducing edema.

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Author contributions: **Conceptualization-** All authors; **Investigation-** All authors; **Methodology-** All authors; **Project administration-** All authors; **Supervision-** Carlos Alberto Costa Neves Buchala; **Writing - original draft-** All authors; **Writing-review & editing-** All authors.

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The authors declare no conflict of interest.

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It was performed.

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