OPEN ACCESS
BY-NC-ND
Signatory of DORA
Plural Episteme
Interdisciplinary Open Access Journal
Received: 11/02/2024
Accepted: 07/04/2025
Published: 15/05/2025
https://doi.org/10.56183/plepist.v3i1.657

# Integration of orthognathic surgery, implantology and prosthetics in the functional and aesthetic restoration of patients with severe maxillofacial atrophy

**Juan Sebastian Armendàriz Acevedo**
sebasa0507@gmail.com
https://orcid.org/0009-0008-7576-9646
Universidad de Guayaquil
Investigador médico odontológico
Santo Domingo, Ecuador

**Alex Isaias Lema Bonilla**
lemaalex016@gmail.com
https://orcid.org/0009-0002-3002-5615
Odontólogo independiente
Ecuador, Riobamba

**Edison Javier Chicaiza Guerrero**
javier020411g@gmail.com
https://orcid.org/0009-0005-2035-1363
Ministerio de salud pública
Quito - Ecuador

**Reyes Nieto Jorge Isaac**
i.reyes2010@hotmail.com
https://orcid.org/0009-0002-2004-9525
Ministerio de Salud Pública del Ecuador
Quito- Ecuador

**Richard Javier Varas Peñaloza**
richardvaras123@gmail.com
https://orcid.org/0009-0008-0999-1214
Universidad Central del Ecuador
Odontólogo general
Quito, Ecuador

**Katherin Alexandra Orozco Yanza**
katyoy01@gmail.com
https://orcid.org/0009-0000-4527-4257
Ministerio de Salud Publica
Guano, Ecuador

## ABSTRACT

Severe maxillofacial atrophy, resulting from trauma, congenital defects, or prolonged edentulism, presents significant challenges in functional and aesthetic rehabilitation. The loss of alveolar bone and supporting structures often hinders traditional implant placement due to insufficient bone height and volume. Traditional methods, such as bone grafting and sinus lifting, have limitations, including prolonged treatment times and varying success rates. The integration of orthognathic surgery, implantology (particularly zygomatic implants), and prosthetics offers innovative solutions, addressing both functional and aesthetic needs in patients with severe maxillary atrophy. This narrative review adopts an integrative and thematic approach to evaluate the combination of orthognathic surgery, implantology, and prosthetics in managing severe maxillofacial atrophy. A systematic search of databases, including PubMed, ScienceDirect, and Google Scholar, was conducted for studies published between 2010 and 2024. The search included terms such as "severe maxillary atrophy," "orthognathic surgery," and "implant-supported prosthetics." Studies were selected based on clinical, functional, and aesthetic outcomes from both surgical and prosthetic interventions. The review identified key studies demonstrating the effectiveness of combining orthognathic surgery with advanced implantology and prosthetics. Zygomatic implants, in particular, showed a high survival rate (96.3%), while subperiosteal implants provided enhanced soft tissue stability. Orthodontic interventions were also crucial, facilitating successful prosthetic outcomes. Prosthetic rehabilitation yielded immediate functional and aesthetic improvements with temporary screw-retained acrylic bridges, with minimal complications. The integration of orthognathic surgery, implantology, and prosthetics offers a promising approach for rehabilitating patients with severe maxillofacial atrophy. Further studies with larger sample sizes and extended follow-up periods are needed to solidify long-term outcomes and refine treatment protocols.

**Keywords:** Severe maxillary atrophy, orthognathic surgery, zygomatic implants, subperiosteal implants, prosthetic rehabilitation, aesthetic outcomes, functional restoration.

## INTRODUCTION

Dental injuries accompanied by facial fractures are the most common in maxillofacial emergencies (Tuna et al., 2012; Lindqvist et al., 1986). There may be multiple soft- and hard-tissue injury in the patient with maxillofacial defects secondary to motor vehicle accidents, which include neurologic involvement and fractures, and/or avulsions of the temporo mandibular joint, maxilla, mandible, teeth, and supporting Skeletal fracture is often accompanied by fracture of those bones that are near this maxilla (in addition to varying degrees of involvement of the overlying soft tissues like the eyes, nasal airways, paranasal sinuses and tongue) (Lindqvist et al., 1986).(Sykes et al., 2002) Treatment of facial fractures is achieved by reduction and immobilization or fixation of the broken pieces of the bony sections,, followed by dental adjustments and replacements of damaged and missing teeth and soft tissues when required (Sykes et al., 2002). Severe maxillofacial atrophy is a complicated clinical picture, concurrent with gradual alveolar bone and supporting structures loss, usually caused by trauma, congenital anomalies, oncological resection, or long-term loss of teeth (Cakan et al., 2006). This condition will present considerable obstacles to both function and aesthetic oral rehabilitation, in particular when placement of traditional implants is hampered by insufficient amounts of bone height and volume.

Therefore, rehabilitation of patients with severe maxillary atrophy remains a significant challenge in maxillofacial surgery. Traditional approaches such as bone grafting, sinus lifting, and guided bone regeneration have provided

foundational methods to rebuild lost bone volume. However, these techniques are often time-consuming, require multiple surgical interventions, and may be associated with increased morbidity and variable outcomes. In response to these limitations, alternative techniques like Le Fort I osteotomy with bone grafting, zygomatic implants, and custom prosthetic planning have been developed to provide more stable and efficient treatment pathways, especially in cases with extreme atrophy or poor bone quality (Balan et al., 2017). Zygomatic implants, introduced by Branemark in 1997 for the prosthetic rehabilitation of patients with serious and extended defects of the jaws caused by post-oncological resections, trauma or congenital malformations, have proven over the years a valid alternative in the treatment of atrophy of the jaws, presenting high success rates (96% in 10 years) (Morton et al., 2000)

Functionality and prosthetic success are critical metrics in assessing implant effectiveness. The increased expectation for a pleasant aesthetic result from the patient is something that increases the challenge for successful oral rehabilitation. In this context, the advancements in tissue engineering, bone regeneration, bone substitute biomaterials, implant surface, and design have promoted the development of new materials and techniques for the successful treatment of complex cases (Hinze et al., 2013; Pia et al., 2012).

Despite the clinical benefits of an interdisciplinary approach, careful coordination among surgical and prosthetic teams is essential to minimize complications, control treatment costs, and enhance patient satisfaction. This narrative review aims to explore the integration of orthognathic surgery, implantology, and prosthetic rehabilitation in the functional and aesthetic restoration of patients with severe maxillofacial atrophy, highlighting current techniques, challenges, and future directions.

## METHODS

This narrative review employs an integrative and thematic approach to explore the combined application of orthognathic surgery, implantology, and prosthetics in the functional and aesthetic rehabilitation of patients with severe maxillofacial atrophy. Relevant studies were identified through systematic searches in scholarly databases including PubMed, ScienceDirect, and Google Scholar, covering publications from the last 15 years. The review follows a qualitative synthesis framework, emphasizing the evolution of treatment protocols and the interdisciplinary nature of surgical and prosthetic interventions in complex maxillofacial rehabilitation.

Targeted search terms included: "severe maxillary atrophy," "orthognathic surgery," "implant-supported prosthetics," "zygomatic implants," "bone augmentation," "functional rehabilitation," and "aesthetic outcomes in maxillofacial surgery." Boolean operators such as AND and OR were used to enhance search specificity and breadth, ensuring the inclusion of clinically relevant and evidence-based studies.

### Inclusion and Exclusion Criteria

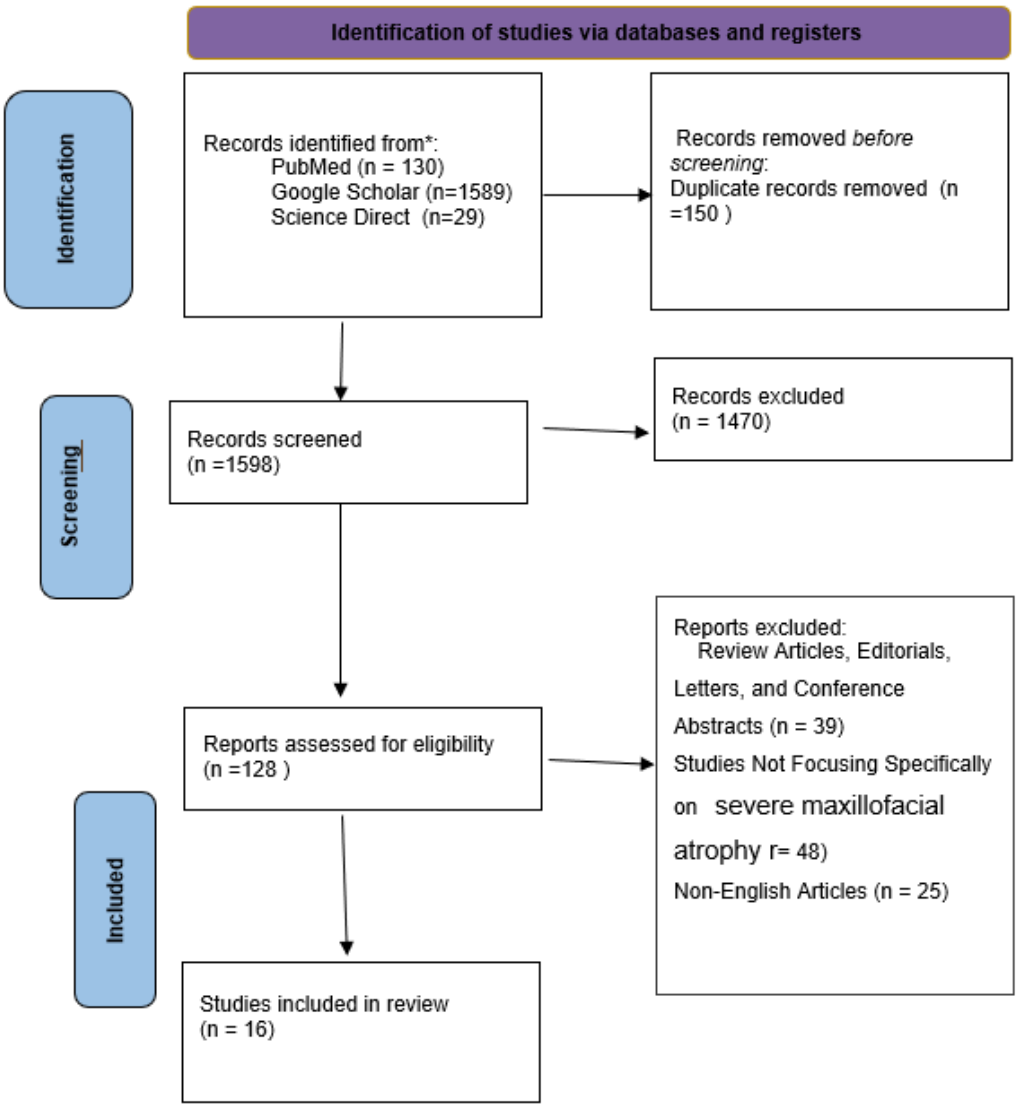
The inclusion criteria for this narrative review encompassed clinical studies, case series, systematic reviews, and prospective cohort studies focusing on the surgical and prosthetic management of severe maxillofacial atrophy in adult patients. Only English-language articles published between 2010 and 2024 were considered. Studies were selected based on their focus on clinical, functional, and aesthetic outcomes related to orthognathic surgery, implant placement (including zygomatic and pterygoid implants), and prosthetic rehabilitation. Exclusion criteria included studies addressing only minor bone loss without interdisciplinary interventions, animal or in vitro research, case reports lacking sufficient clinical data, and those with unclear methodology.

### Data Categorization and Analysis:

From an initial pool of 1598 articles identified through title and abstract screening, 16 were included for full-text review. The selected studies were categorised into surgical techniques, prosthetic outcomes, and functional/aesthetic impacts. This thematic approach allowed a focused evaluation of how each domain contributes to the rehabilitation of severe maxillofacial atrophy. Surgical studies included approaches like Le Fort I osteotomy, zygomatic implants, and bone grafting, with emphasis on stability and bone integration. Prosthetic-focused research analysed implant-supported restorations, CAD/CAM techniques, and prosthesis longevity. Functional and aesthetic studies assessed patient satisfaction, facial harmony, and masticatory function using digital tools and intraoral scanning.

This structure enabled a comprehensive synthesis to evaluate the effectiveness of multidisciplinary treatment approaches and identify current clinical gaps in managing advanced maxillofacial atrophy.

***Figure 1***. Prisma Flow Diagram




## RESULTS AND DISCUSSION

Maxillofacial defects extending over extensive areas present functional and cosmetic complications due to both birth defects and surgical tumor removal, as well as traumatic injuries (Uğurlu et al., 2007). The absence of teeth causes alveolar bone resorption together with remodeling until it results in an atrophic residual ridge. Treatment plans based on prosthetic rehabilitation methods help restore both structural and functional, and presentable qualities in cases of severe soft tissue plus hard tissue defects (Tuna et al., 2012).

### Orthodontic Interventions in Rehabilitation

Especially in situations involving structural alignment and occlusal problems, orthodontic therapies are essential to the rehabilitation of difficult dental cases. Orthodontic treatments help address crowding and enamel issues and positional defects before managing restorative work, including prostheses placement and restoration work. The entire rehabilitation plan benefits functionally from orthodontic treatments, which produce both an attractive teeth appearance and functional enhancement. A reliable outcome combined with visual appeal requires orthodontic treatment that works together with other specialties, which proves its essential role in total rehabilitation planning. Maiorana et al (2020) mention that orthodontic treatment becomes essential to prepare the mouth cavity for elaborate rehabilitation procedures (Maiorana et al., 2020). Orthodontic treatment became essential because it needed to create room for implant placement by straightening all remaining teeth. Functional, along with aesthetically acceptable results from prosthetic procedures, required the inclusion of orthodontic intervention in the multidisciplinary treatment plan. Patients achieved successful clinical outcomes through the active coordination between orthodontic specialists and all other dental professionals involved. A successful result required

collaboration between detachable prosthesis and adhesive dentistry to create the solution. The treatment plan needs modifications, specifically tailored to individual patient needs, because orthodontic solutions are sometimes restricted according to this data. Doulkeridou et al. (2020) demonstrated how orthodontics operates within multidisciplinary care for a periodontitis patient. Orthodontic treatment proved its effectiveness after periodontal health improvement through various non-surgical and surgical therapies(Doulkeridou et al., 2020). The orthodontic intervention successfully joined comprehensive patient care plans with other dental specialties because it resolved both functional and aesthetic concerns. Agarwal et al indicate that orthodontic forced eruption through teeth works as a treatment for subgingival maxillary central incisor fractures to restore prosthetics. Later, restorative procedures became possible because teeth extrusion through braces enables direct treatment access to the fracture border (Agarwal et al., 2020). The restorative procedure benefits from better cosmetic outcomes while preventing future complications through this technique. Thus, in complicated instances of oral rehabilitation, orthodontic procedures are essential to attaining both functional and cosmetic success (Gökçen-Röhlig et al., 2009)(Batisse et al., 2022).

**Implant Success and Prosthetic Outcomes**

Combination of the orthognathic surgery, implantology, and prosthetics for rehabilitation of the severely maxillofacial atrophy patients has been the sphere of increasing interest. Works of research like Zielinski et al (2025) emphasize the need to incorporate such modalities to perfect both functional and aesthetic restoration for maxillary patients with extensive bone loss. Zielinski et al. (2025) compared clinical outcomes related to two types of implants: zygomatic and subperiosteal, in patients with severe maxillary atrophy (Zielinski et al., 2025). Their research found equal implant survival rates for both implant types, with zygomatic implant survival rates of 96.3% slightly lower than a 97.1% survival rate for subperiosteal implants. However, although identical survival rates were seen in both groups, complications differed with zygomatic implants having higher rates of sinus-related complications (12.4%) and risks of orbital damage, which can be a tremendous problem in maxillofacial reconstruction (Zielinski et al., 2025).

The study highlighted the significance of soft tissue strength in providing long-term success with subperiosteal implant, showing superior soft tissue integration with fewer cases of peri-implantitis 5.6%) compared to a 12.4% complication rate in the zygomatic implant group. This result is consistent with studies whose findings show that the individualized nature of the subperiosteal implants, which have a better fit to the anatomy of the patient, may promote improved soft tissue stability and a lower risk of infection (Zielinski et al., 2025). In terms of procedural efficiency, zygomatic implants offer a shorter procedure time (roughly 177 minutes), a factor that is facilitated by contrast to subperiostealimplants that require more elaborate processes of custom design and bone grafting, hence taking longer (Zielinski et al., 2025). However, this reduced operating time carries the potential cost of increased risks of sinus and orbital complications, a reminder about the factors that have to be balanced while considering an appropriate treatment plan.

Prosthetic outcomes have also tended to be favorable for both groups,, as patients in both zygomatic implants and subperiosteal implants groups received immediate loading and aesthetic restoration within 24 hours. Both implant types permitted implantation of temporary screw-retained acrylic bridges for patients who immediately gained function and cosmetic improvements (Zielinski et al., 2025). Regardless, both implant modalities have high rates of survival and desirable prosthetic results, and the decision between zygomatic and subperiosteal implants needs to be supported by the individual anatomical and functional requirements of the patient. Zygomatic implants are superior to immediate functional loading time and shorter procedural time, whereas subperiosteal implants are superior to better soft tissue stability and fewerr complications, making them a more desirable option in more anatomically challenging situations. The results from Zielinski et al. (2025) emphasize the need for individual treatment planning based on the advantages and shortcomings of each approach.

Another study conducted by Balan et al. (2017) explored the use of zygomatic implants as a rehabilitative solution for patients with severe maxillary atrophy, focusing on both aesthetic and functional outcomes. The case series included 18 patients (males and females) median age of 62, presenting with advanced periodontitis and extensive maxillary bone loss (Balan et al., 2017). Conventional techniques that would be used to manage such situations include sinus lifting, bone grafting, and Le Fort I osteotomy; however, such methods most often need periods of prolonged healing and do not provide for an early prosthetic loading. In contrast, Balan et al. introduced a surgical protocol including the placement of 29 zygomatic implants together with 99 standard implants for immediate loading and fixed prosthetic rehabilitation. The surgical procedure guaranteed that the implants would be firmly fixed into the zygomatic bone, avoiding complex bone augmentation. Not only did this method reduce surgical morbidity, but it also delivered improved support of prosthetic apparatus. From an aesthetic perspective, patients improved remarkably in terms of face appearance, specifically mid-face support and oral symmetry,, because of the restoration of the maxillary volume and dentition. Functionally, all the patients were fitted with immediate provisional prostheses that significantly improved the functions of chewing, speaking, and smiling with confidence. In a 12-month follow-up, no implants were lost, and the post-operative period was mostly uncomplicated with no adverse effects, suggesting a very high clinical success rate. As a whole, the study brings forth the bi-

directional advantage of zygomatic implants in the restoration of form and function of the severely atrophic maxilla, providing an alternative to traditional grafting with significantly better patient-reported outcomes in terms of aesthetics and function.

In addition to it, another study by Korn et al. (2022) investigates the use of a new generation of subperiosteally placed, rigid multi-vector bone-anchored patient-specific implants in treating severely atrophic maxillae. This retrospective study, conducted in Hannover Medical School, examined the stability, prosthetic restoration, as well as complications of 13 implants in 10 patients after an average of 8.2 months of treatment (Korn et al., 2022). No implants were lost, but one immediately postoperatively and two during the follow-up period. The implants were well tolerated: all showed clinical stability throughout the observation period. Prosthetic restoration was achieved for all patients with follow-up periods of over 2 months. Functionally, the implants stabilized substantially and allowed for an effective prosthetic restoration, as well as better chewing function. There were also favourable aesthetic results as the patients were satisfied with their facial appearance and comfort in the mouth. Although minor complications observed included screw fracture, infection and exposure of framework, they did not cause implant failure. This implies that the patient-specific implants could represent an excellent alternative to those patients who previously failed with conventional dental implants or with expanded augmentations such as zygomatic implants. The study concludes that larger sample sizes and a consequent lengthening of the observation period are necessary to draw more conclusive conclusions about the long-term effectiveness of this technique (Korn et al., 2022).

**Orthognathic Surgery Approaches**

Maxillofacial atrophy severely affected patients underwent transformative progress in oral rehabilitation surgery when incorporating orthognathic surgery, advanced implantology, and prosthodontics (Benech et al., 2011). Once a sub-discipline, Orthognathic surgery (OGS) has now transformed into a diverse multi-disciplinary backbone of integrated oral reconstruction, specifically in patients with severe bone dissipation (Beek et al., 2022). One of the most important advances is the combination of minimally invasive methods with advanced imaging, a computer-guided platform to achieve enhanced accuracy, eliminate morbidity, and shorten recovery times. Such surgical interventions as Le Fort I osteotomy are the cornerstone of treatments addressing vertical and horizontal deficiencies in the maxilla, and, many times, for complex reconstructions, it is the first step. The application of zygomatic implants with up to a 96% long-term success rate within ten years has become widespread for patients with poor maxillary bone quality (Korn et al., 2022). Correspondingly, pterygoid implants allow viable posterior support to prosthetic restorations in circumstances of posterior maxillary atrophy, obviating the need for sinus augmentation.

The armamentarium of the surgeon is expanded further by bone augmentation techniques. Autogenous bone grafting, sinus lifting,, and guided bone regeneration are continuing practices, each specific case oriented in anatomic and clinical requirements. However, these procedures are generally associated with longer treatment durations and a greater morbidity. Notably, the synergy between subperiosteally anchored patient-specific implants and digital planning technologies has presented a promising alternative, with recent studies revealing 100% implant survival after average follow-ups of 8.2 months, in patients, even with previous implant failures (Korn et al., 2022). Composite Fibula flaps construction techniques with implant embedded have also demonstrated significant enhancement to speech, mastication, and facial aesthetics when compared to traditional prosthetic solutions (Morocho Sánchez et al., 2025). These surgical frameworks are supplemented by computer-assisted navigation and robotic surgery, technology adopted from neurosurgery and orthopedics, and now used to perform safer, more accurate, maxillofacial surgical procedures (Kuruoglu et al., 2021)The trend towards minimally invasive procedures such as TMJ arthroscopy and sialendoscopy is representative of a wider paradigm around outcomes being patient-centered and trauma. Overall, surgical innovation with its implementation of personalized implants, on a robotic platform, or interdisciplinary teamwork continues to redefine oral rehabilitation, in terms of function, aesthetic gratification, and availability for patients with complex maxillofacial deficits.

**Prosthetic Outcomes in Severe Maxillary Atrophy**

Prosthetic rehabilitation in cases of severe maxillary atrophy presents numerous challenges and requires a comprehensive, interdisciplinary approach to restore oral function and aesthetics. As described in Giammarinaro's (2024) case series, patients with severe maxillary atrophy tend to be burdened by anatomical constraints such as diminished bone volume, compromised soft tissue support, and altered occlusal relationships, all of which directly influence the success of prosthetic reconstructions . The conjunction of prosthetic and surgical planning is very important for the correction of such complex anatomical variations and satisfactory results for patients.

In the series used in this presentation, custom prostheses were used after implants were positioned among four patients with advanced decaying maxilla. Detailed radiographic examination and digital treatment planning were used for all cases and enabled the design of prosthetic components to be adapted to the individual anatomical needs (Giammarinaro, 2024). Lip support, midline correction, and occlusal stability are important parameters that direct prosthetic design, and

materials with high-density polymers and metal frameworks were used to provide the strength and durability in structurally compromised maxillae. The importance of prosthetic integration with implants, especially as related to passive fit and biomechanical stresss, is emphasized by this study. Notably, all four cases reported stable integration of implant-prosthesis without mechanical failure and implant mobility,, confirming the efficacy of planning and performance of the given treatment. Screw-retained prostheses were mainly employed because of their retrievability and improved maintenance; however, cement-retained solutions may be reasonable in cases based on individual patient considerations (Giammarinaro, 2024).

Patient-reported outcomes were equally significant. All the patients reported high-level satisfacwithbout aesthetics, speech intelligibility, and comfort, according to the report. Measurable improvements could be seen in post-rehabilitation functional metrics like the masticatory efficiency as well as the occlusal performance, although no specific figures were given in the commentary. The clinical success in this series is consistent with the benchmarks described in comparable studies, indicating further the feasibility of implant-supported prostheses in severely atrophied maxillary situations. Notwithstanding the overall success, Giammarinaro (2024) points out such complications as a risk, such as prosthetic fractures, screw loosening, and soft tissues irritation. However, such complications were not seen during the reported follow up indicating that sound prosthetic planning and teamwork will help overcome these complications.

Technological initiatives were also mentioned, especially CAD/ CAM and 3D printing,, for enhancing prosthetic accuracy. Digital smile design and intraoral scanning were used for the visualization of and methods of communicating treatment goals to the patient for the management of expectations and operational transparency. In addition to simplifying the workflow, the tools increase the fit and functional outcomes of the final prosthesis (Giammarinaro, 2024). Conclusively, prosthetic results presented in this series reinforce that regardless of the degree of atrophy of the maxilla, successful rehabilitation in such conditions is possible unless appropriate planning, technological advancements in surgery, and tailored solutions in prosthesis are not followed. The cooperation of prosthodontists, surgeons, and technicians plays a critical role in providing predictable, top-quality results that dramatically improve patients oral function, aesthetic components, and quality of life (Giammarinaro, 2024).

Another study by Molina et al. (2021) explored the surgical and prosthetic management of a 70-year-old edentulous female with a severely atrophic maxilla through a combination of nasal and sinus lifts alongside the placement of incisive canal implants (Molina et al., 2021). The report indicated that an overdenture retained by five implants was used, supported by anatomical landmarks such as the nasopalatine canal and lateral sinus walls, thereby providinga biomechanically stable and esthetically pleasing rehabilitation. The authors outlined the fact that implant-supported overdentures are a viable alternative to traditional prostheses, especially for edentulous patients in severe bone loss (Molina et al., 2021). This approach received significant gains in function on the prosthesis. In particular, patients had pronounced improvement in such metrics as stability, retention, bite force, chewing efficiency, and total oral care, as compared with traditional complete dentures (Molina et al., 2021). Such results are in line with the previous findings that implant-supported overdentures improve retention and prosthesis utilization, in particular, when complete resorption of the maxilla in such a condition occurs(Chrcanovic et al., 2014).

Statistically, shorter implants utilized herein, measuring ≤8 mm in length, had similar survival rates to longer conventional implants, consistent with results of a meta-analysis by Papaspyridakos et al.(2012), which reported a mean survival rate of 96.1% for short implants over 5 years (Papaspyridakos et al., 2012). In addition, the study had five L-PRF membranes and natural bovine bone grafts for sinus and nasal floor elevation, consistent with evidence of obovine-derivеded xenografts as a predictable and osteoconductive option for vertical augmentation (González-García et al., 2016) About prosthetic execution, Molina et al. (2021) used a carbon-based implant retention system, angulated abutments (15° posterior, 0° anterior, Ø 3.8 mm, GH 6.5 mm), implant attachments, and 750 g retention inserts within the complete denture. Such design considerations are essential when evaluating occlusal forces on the maxillary arch, especially for triangular-shaped jaws. Importantly, clinical follow-up at one month showed successful osseointegration and health of tissues around the osseointegrated implant as well as successful function of the prosthesis (Molina et al., 2021). Lastly, the study emphasizes that traditionally avoided nasopalatine canal implants can be a reasonably sound anterior anchorage point for bone with enough cortical bone. This innovation provides a triangular distribution of an implant that favors prosthetic biomechanics. These results are consistent with previous studies by Candel-Martíet al. (2012), who published a 94.7% success rate of implants placed in the nasopalatine canal over 3 years' follow-up (Candel-Martí et al., 2012). Therefore, Molina et al. (2021) offer strong evidence that the combination of a comprehensive surgical treatment, including sinus and nasal augmentation with modern prosthetic design, can result in high-functioning, aesthetic, and durable outcomes, even in instances of extreme maxillary atrophy (Molina et al., 2021).

**Discussion**

The integration of orthognathic surgery, implantology, and prosthetics plays a pivotal role in managing severe maxillofacial atrophy, where conventional treatments often fall short. A combination of innovative surgical procedures,

including zygomatic or subperiosteal implants together with orthodontic and prosthetic tactics, helps resolve the functional and aesthetic problems of severe alveolar bone loss(Zielinski et al., 2025)(Balan et al., 2017) (Uğurlu et al., 2007)(Tuna et al., 2012). In traumas or post-oncological resections, implant survival and soft tissue integration become quite important metrics. Zielinski et al. (2025) showed similar outcomes for both zygomatic and subperiosteal implants (96.3% vs 97.1%); the subperiosteal implants had fewer sinus-related problemsand better soft tissue response (Zielinski et al., 2025). Similarly, Balan et al(2017)alsoo report positive results with zygomatic implants with immediate load, which improves both the mid-facial symmetry and the chewing function (Balan et al., 2017).

Orthodontic interventions are cardinal in the adjustment of teeth, site preparations for implantations, and the harmonic arrangement of prosthetics. According to Thomas et al., (2021) Maiorana et al. (2017), and Batisse et al. (2022, Interdisciplinary collaboration is vital, especially in microdontia or microdontia patients with residual periodontal disease (Thomas et al., 2021)(Maiorana et al., 2017). Doulkeridou et al. (2020) and Agarwal et al. (2020) also agree with the use of orthodontics in facilitating prosthetic planning, especially with periodontally compromised or fractured teeth (Agarwal et al., 2020)(Maiorana et al., 2020)(Doulkeridou et al., 2020). These results persistently reinforce that when the care is coordinated, prosthetic fit and occlusal alignment can improve, as well as the long-term stability. Functionally, the reviewed studies are in agreement with immediate loading protocols. Zielinski et al. (2025) and Balan et al. (2017) reported successful use of temporary screw-retained prostheses in 24 hours following surgery. This rapid method improves patient satisfaction and treatment length without affecting implant survival. Aesthetic outputs – in particular, restoration of volume in the midface – were uniformly enhanced through consecutive studies and lent patient confidence and orofacial harmony.

Though these are encouraging findings, there are certain limitations. Research tells that although implants provide excellent rates of survival, complications, such as sinus issues and soft tissue integration issues, remain (Zielinski et al., 2025). Furthermore Multidisciplinary treatments are complex and co, so they need to be considered very keenly. Larger sample size studies with longer follow-up are required for long-term effectiveness and optimization of treatment methods (Korn et al., 2022). By extrapolating from these results, the clinical implications show that individualized treatment programs continue to be the bedrock of successful rehabilitation since every patient's peculiar anatomical challenges guide the best mode of treatment. Finally, although the combination of orthognathic surgery, implantology, and prosthetics involves many advantages when addressing severe maxillofacial atrophy, it is necessary to continue the research to perfect methods and reduce complications. To offer the best functional and aesthetic result for these patients, coordinated multidisciplinary team efforts are still vital.

## CONCLUSIONS

In conclusion, the integration of orthognathic surgery, implantology, and prosthetic rehabilitation offers a promising approach to addressing severe maxillofacial atrophy. Zygomatic implants, subperiosteal implants, and advanced surgical techniques such as Le Fort I osteotomy provide viable solutions for patients with significant bone loss, restoring both functionality and aesthetics. While these treatments show high success rates, careful patient selection and individualized treatment plans are essential to minimize complications and optimize outcomes. Continued advancements in digital planning, materials, and interdisciplinary coordination will further enhance the effectiveness of these rehabilitative strategies, offering hope for improved quality of life in affected patients.

## REFERENCES

Agarwal, K., Singh Samant, P., Shreya, Ashok, N., & Shyamal, R. (2020). Multidisciplinary approach for management of traumatic subgingival crown-root fractured central incisor: A case report. *IP Indian Journal of Conservative and Endodontics*, *5*(1), 22–26. https://doi.org/10.18231/J.IJCE.2020.006

Balan, I., Di Girolamo, M., Lauritano, D., & Carinci, F. (2017). Treatment of severe atrophic maxilla with zygomatic implants: a case series. *Oral & Implantology*, *10*(3), 317. https://doi.org/10.11138/ORL/2017.10.3.317

Batisse, C., Cousson, P. Y., Nicolas, E., & Bessadet, M. (2022). Aesthetic and Functional Rehabilitation of Patients with Genetic Microdontia: A Multidisciplinary Approach. *Healthcare (Switzerland)*, *10*(3). https://doi.org/10.3390/HEALTHCARE10030485

Beek, D. M., Baan, F., Liebregts, J., Bergé, S., Maal, T., & Xi, T. (2022). Surgical accuracy in 3D planned bimaxillary osteotomies: intraoral scans and plaster casts as digital dentition models. *International Journal of Oral and Maxillofacial Surgery*, *51*(7), 922–928. https://doi.org/10.1016/J.IJOM.2021.11.016

Benech, A., Mazzanti, C., Arcuri, F., Giarda, M., & Brucoli, M. (2011). Simultaneous le Fort i osteotomy and computer-guided implant placement. *Journal of Craniofacial Surgery*, *22*(3), 1042–1046. https://doi.org/10.1097/SCS.0b013e318210765d

Cakan, U., Anil, N., & Aslan, Y. (2006). Prosthetic rehabilitation of a mandibular gunshot defect with an implant-supported fixed partial denture: A clinical report. *Journal of Prosthetic Dentistry*, *95*(4), 274–279. https://doi.org/10.1016/J.PROSDENT.2006.01.011

Candel-Martí, E., Carrillo-García, C., Peñarrocha-Oltra, D., & Peñarrocha-Diago, M. (2012). Rehabilitation of atrophic posterior maxilla with zygomatic implants: Review. *Journal of Oral Implantology*, *38*(5), 653–657. https://doi.org/10.1563/AAID-JOI-D-10-00126

Chrcanovic, B. R., Albrektsson, T., & Wennerberg, A. (2014). Reasons for failures of oral implants. *Journal of Oral Rehabilitation*, *41*(6), 443–476. https://doi.org/10.1111/JOOR.12157

De Freitas, R., Kaizer, O. B., Hamata, M. M., De Resende, D. R. B., & De Oliveira Fortes Kaizer, R. (2006). Prosthetic rehabilitation of a bone defect with a teeth-implant supported, removable partial denture. *Implant Dentistry*, *15*(3), 241–247. https://doi.org/10.1097/01.ID.0000234643.17874.50

Doulkeridou, C., Vouros, I., Petridis, A., Athanasia-Eirini, Z., & Theodoridis, C. (2020). Interdisciplinary Approach in Periodontology - A Mini-Review and A Report of Two Complex Cases. *Dental Research and Oral Health*, *03*(03). https://doi.org/10.26502/DROH.0025

Gökçen-Röhlig, B., Atalay, B., Baca, E., Işik, D., & Meriç, U. (2009). Prosthetic rehabilitation of a patient with a mandibular defect caused by a gunshot wound. *Journal of Craniofacial Surgery*, *20*(5), 1614–1617. https://doi.org/10.1097/SCS.0B013E3181B14749

González-García, R., Monje, A., Moreno-García, C., & Monje, F. (2016). Endoscopically-Assisted Zygomatic Implant Placement: A Novel Approach. *Journal of Maxillofacial and Oral Surgery*, *15*(2), 272–276. https://doi.org/10.1007/S12663-015-0825-Y

Giammarinaro*, E. (2024). *Implant Rehabilitation in Patients with Severe Maxillary Atrophy*. https://www.hilarispublisher.com/. https://www.hilarispublisher.com/open-access/implant-rehabilitation-in-patients-with-severe-maxillary-atrophy.pdf

Hinze, M., Vrielinck, L., Thalmair, T., Wachtel, H., & Bolz, W. (2013). Zygomatic Implant Placement in Conjunction with Sinus Bone Grafting: The "Extended Sinus Elevation Technique." A Case-Cohort Study. *The International Journal of Oral & Maxillofacial Implants*, *28*(6), e376–e385. https://doi.org/10.11607/JOMI.TE18

Korn, P., Gellrich, N. C., Spalthoff, S., Jehn, P., Eckstein, F., Lentge, F., Zeller, A. N., & Rahlf, B. (2022). Managing the severely atrophic maxilla: Farewell to zygomatic implants and extensive augmentations? *Journal of Stomatology, Oral and Maxillofacial Surgery*, *123*(5), 562–565. https://doi.org/10.1016/J.JORMAS.2021.12.007,

Kuruoglu, D., Yan, M., Bustos, S. S., Morris, J. M., Alexander, A. E., & Sharaf, B. (2021). Point of care virtual surgical planning and 3D printing in facial gender confirmation surgery: a narrative review. *Annals of Translational Medicine*, *9*(7), 614–614. https://doi.org/10.21037/ATM-20-6369

Lindqvist, C., Sorsa, S., Hyrkäs, T., & Santavirta, S. (1986). Maxillofacial fractures sustained in bicycle accidents. *International Journal of Oral and Maxillofacial Surgery*, *15*(1), 12–18. https://doi.org/10.1016/S0300-9785(86)80005-9

Maiorana, C., Andreoni, D., Polacco, P., & Poli, P. P. (2020). Multidisciplinary Oral Rehabilitation of a Severely Compromised Dentition. *Case Reports in Dentistry*, *2020*. https://doi.org/10.1155/2020/2429505

Maiorana, C., Poli, P. P., Deflorian, M., Testori, T., Mandelli, F., Nagursky, H., & Vinci, R. (2017). Alveolar socket preservation with demineralised bovine bone mineral and a collagen matrix. *Journal of Periodontal and Implant Science*, *47*(4), 194–210. https://doi.org/10.5051/JPIS.2017.47.4.194

Molina, G., Mazzey, G., & Coronado, C. (2021). "Surgical and prosthetic management of a severely atrophic maxilla, using nasal and sinus lifts along with incisive canal implants".A case report. *Oral and Maxillofacial Surgery Cases*, *7*(1), 100210. https://doi.org/10.1016/J.OMSC.2021.100210

Morocho Sánchez, W. I., Guailla Rea, G. P., Ganchozo Peralta, D. B., Cáceres Flores, M. F., & Fernandez Montalvo, P. E. (2025). Effectiveness of digital planning-assisted orthognathic surgery combined with implantology in the treatment of severe malocclusions: a narrative review of functional and aesthetic outcomes. *Plural Episteme: Interdisciplinary Open Access Journal*, *3*(1), 2–11. https://doi.org/10.56183/PLEPIST.V3I1.654

Morton, D., Fridrich, K., Aquilino, S. A., & Fridrich, T. A. (2000). Interdisciplinary treatment of severe maxillofacial trauma: A clinical report. *The Journal of Prosthetic Dentistry*, *84*(2), 133–135. https://doi.org/10.1067/MPR.2000.107790

Papaspyridakos, P., Chen, C. J., Singh, M., Weber, H. P., & Gallucci, G. O. (2012). Success criteria in implant dentistry: A systematic review. *Journal of Dental Research*, *91*(3), 242–248. https://doi.org/10.1177/0022034511431252

Pia, F., Aluffi, P., Crespi, M. C., Arcuri, F., Brucoli, M., & Benech, A. (2012). Intraoral transposition of pedicled temporalis muscle flap followed by zygomatic implant placement. *Journal of Craniofacial Surgery*, *23*(5). https://doi.org/10.1097/SCS.0B013E31825B34F6

Sykes, L. M., Wolfaardt, J. F., & Sukha, A. (2002). Prosthodontic rehabilitation of a patient with total avulsion of the maxilla: A clinical report. *Journal of Prosthetic Dentistry*, *88*(4), 362–366. https://doi.org/10.1067/MPR.2002.128125

Thomas, C., Vaysse, F., Courset, T., Nasr, K., Courtois, B., L'Homme, A., Chassaing, N., Vinel, A., Bailleul-Forestier, I., Raynaldy, L., & Laurencin-Dalicieux, S. (2021). From child to adulthood, a multidisciplinary approach of multiple microdontia associated with hypodontia: Case report relating a 15 year-long management and follow-up. *Healthcare (Switzerland)*, *9*(9). https://doi.org/10.3390/HEALTHCARE9091180

Tuna, E. B., Ozgen, M., Cankaya, A. B., Sen, C., & Gencay, K. (2012). Oral Rehabilitation in a Patient with Major Maxillofacial Trauma: A Case Management. *Case Reports in Dentistry*, *2012*, 267143. https://doi.org/10.1155/2012/267143

Uğurlu, K., Sacak, B., Hüthüt, I., Karsidag, S., Sakiz, D., & Baş, L. (2007). Reconstructing Wide Palatomaxillary Defects Using Free Flaps Combining Bare Serratus Anterior Muscle Fascia and Scapular Bone. *Journal of Oral and Maxillofacial Surgery*, *65*(4), 621–629. https://doi.org/10.1016/J.JOMS.2005.12.075

Zielinski, R., Okulski, J., Piechaczek, M., Łoś, J., Sowiński, J., Sadowska-Sowińska, M., Kołkowska, A., Simka, W., & Kozakiewicz, M. (2025). Five-Year Comparative Study of Zygomatic and Subperiosteal Implants: Clinical Outcomes, Complications, and Treatment Strategies for Severe Maxillary Atrophy. *Journal of Clinical Medicine*, *14*(3). https://doi.org/10.3390/JCM14030661