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CASE REPORT

Rehabilitating Patients with Atrophic Maxillae via Zygomatic Implants

Sami A Almohefer

Department of Restorative Dental Science, College of Dentistry, University of Hail, Hail, Kingdom of Saudi Arabia

Correspondence: Sami A Almohefer, Department of Restorative Dental Science, College of Dentistry, University of Hail, Hail, Kingdom of Saudi Arabia, Email S.almohefer@uoh.edu.sa

Background: Significant maxillary atrophy poses a considerable obstacle for oral restoration with standard dental implants because of insufficient bone supply. Zygomatic implants provide alternative treatments without a graft by being secured into the sturdy zygomatic bone, enabling support for prosthetic restoration. Thus, zygomatic implants were proposed in this case report as a substitute for costly and lengthy grafting techniques for rehabilitating patients with insufficient bone.

Case Presentation: We describe a 62-year-old male who was diagnosed with maxillary atrophy and who underwent a rehabilitation protocol involving zygomatic implants. Two bilateral zygomatic implants were planned as free-hand surgical procedures because of the lack of a supporting structure to stabilize the surgical template. Prostheses were then placed after 48 hours, and a radiographic follow-up occurred at 24 months. Regular check-ups and proper oral hygiene were maintained. The clinical data and radiographs for the control treatment were obtained throughout the two years following treatment. Patients achieved functional and aesthetic rehabilitation with no major complications reported during the follow-up period. High levels of patient satisfaction and prosthetic function were observed.

Conclusion: This case report highlights the effective rehabilitation of a severely atrophic maxilla using quad zygomatic implants, achieving immediate function and aesthetics with no major complications over two years. Compared with traditional bone grafting, the graftless approach is less invasive, leading to faster recovery and greater patient satisfaction.

Keywords: zygomatic implants, rehabilitation, clinical proficiency, prostheses, atrophic maxilla, function and appearance, occlusion

Introduction

Complete tooth loss, or edentulism, is considered a profoundly negative life event and has been described as the "last sign of disease burden for oral wellness".[1] One of its major consequences is a complex biophysical process of bone resorption, which gradually progresses into an irreversible and debilitating state of jaw atrophy.[2] In the maxilla, this bone loss results in low-density trabecular bone, extremely thin or absent cortical bone, and a narrow, short, or knife-edged residual alveolar ridge.[3] Additionally, the posterior maxilla becomes severely atrophic due to the expansion and pneumatization of the maxillary sinus, further reducing the available bone volume.[4] These anatomical challenges make traditional implant-supported fixed prosthetic rehabilitation of the atrophic edentulous maxilla difficult, as there is often insufficient bone to achieve stable implant placement.[5]

Recent advancements in implant dentistry have provided clinicians with multiple options for addressing the challenges of rehabilitating the atrophic maxilla.[6–8] Autogenous bone grafts are still considered the gold standard for sinus augmentation in such cases.[9] However, this approach poses several issues, including unpredictable graft resorption or rejection, infection risk, delayed functional loading, potential damage to adjacent anatomical structures during graft harvesting, and increased treatment costs.[7] To overcome these limitations, several graftless alternatives have been proposed. These methods are reported to be less invasive, involve fewer complex procedures, reduce treatment costs and morbidity, and allow for immediate loading with faster recovery times.[8,10] Among these options, zygomatic implant rehabilitation has emerged as a promising graftless option for managing atrophic maxillary defects.[8] Kato et al[7]

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demonstrated that long implants anchored in dense zygomatic bone can effectively support a cross-arch fixed dental prosthesis. In a randomized controlled trial, zygomatic implants resulted in fewer implant and prosthetic failures and significantly shorter recovery times (1.3 days vs 444.3 days) than did sinus augmentation with delayed implant placement and conventional loading protocols.[11] Many studies indicate that zygomatic implants provide a less invasive option than bone grafting for individuals with significant maxillary bone loss does, allowing for better prosthetic design and enhancing quality of life.[12,13] Recent innovations in zygomatic implant placement, including the extramaxillary technique, provide further advantages by reducing sinus involvement, improving prosthetic emergence profiles, and enhancing surgical versatility.[14]

Maxillary atrophy resulting from trauma, congenital issues, or other factors poses difficulties for functional and aesthetic restoration because of insufficient bone volume. Zygomatic implants present a practical option by ensuring final support without requiring bone grafts, facilitating quicker and less invasive complete mouth restoration. Therefore, zygomatic implants were suggested in this case report for the rehabilitation of patients with inadequate bone. This case highlights the immediate rehabilitation of a fully edentulous patient via a quad -zygomatic implant protocol performed without surgical guidance. It presents a practical and effective alternative for managing severe maxillary atrophy and sinus pneumatization, particularly when bone grafting is not feasible for the patient. This case contributes to the literature by providing clinical insight into treatment planning, surgical execution, and prosthetic workflows in such complex anatomical conditions, which are particularly relevant in underrepresented regions.

Case Presentation

A 62-year-old male patient was referred to the Hail Dental Centre by a general dentist for the treatment of edentulous upper and lower arches. The patient presented with complete edentulism in both the maxillary and mandibular arches, accompanied by generalized severe bilateral bone loss in the maxilla and moderate bone loss in the mandible. A thorough medical history was taken, followed by clinical and radiographic examinations, including panoramic radiographs of the jaws to assess the available bone in relation to anatomical structures (Figure 1).

Diagnosis and Treatment Plan

Intraoral examination revealed shallow vestibular depth in both arches. Panoramic assessment of the existing bone height indicated that both the anterior and posterior areas of the mandible had adequate bone height. Conversely, the anterior maxillary area presented sufficient bone height, whereas the posterior area was lacking. This difference in bone height

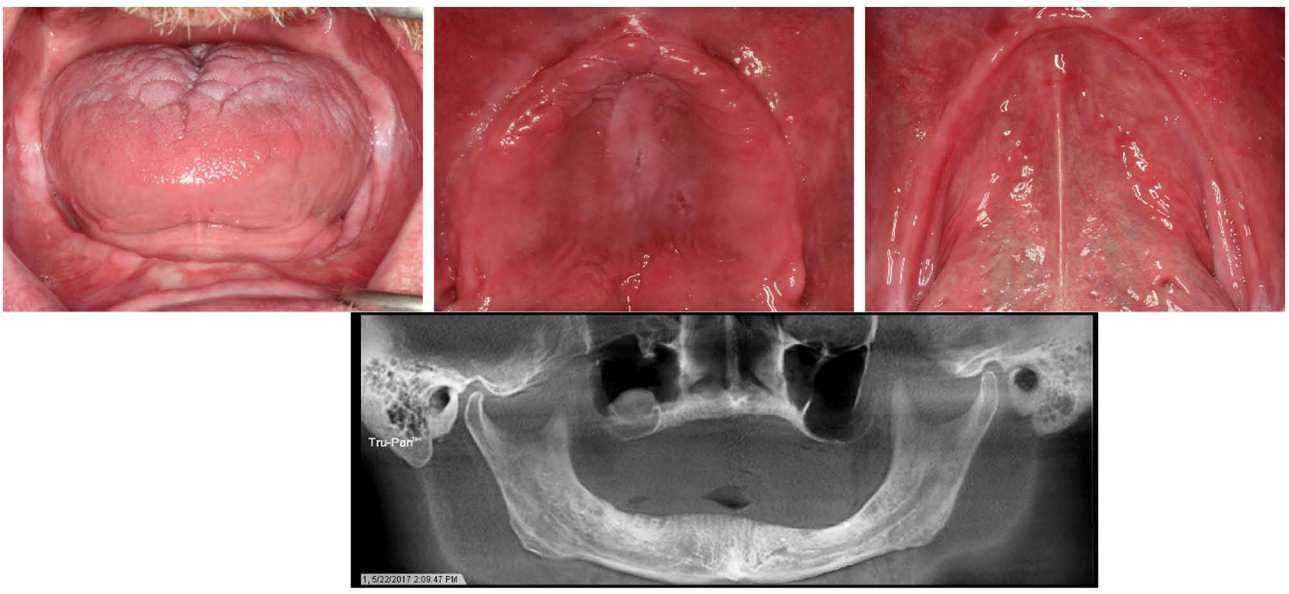

Figure 1 Preoperative clinical and panoramic radiograph images.

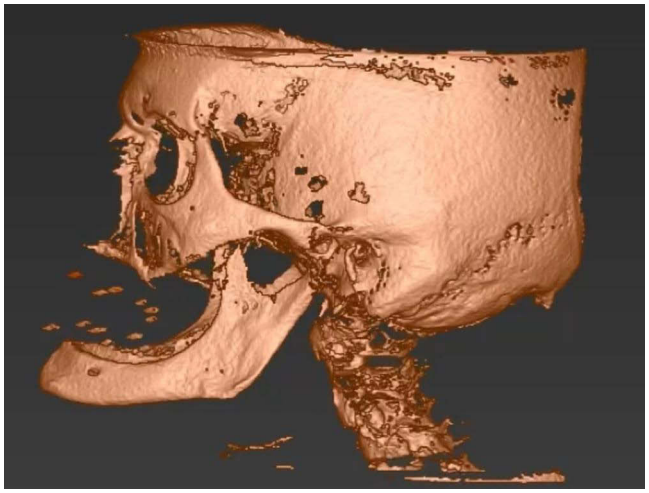

Figure 2 Cone-beam computed tomography shows atrophic maxilla.

could be linked to the level of bone resorption in the posterior maxilla and the extent of maxillary sinus pneumatization. Radiographic evaluation also revealed significant sinus pneumatization in the posterior maxilla and adequate bone height in the anterior maxilla and both mandibular regions, indicating advanced maxillary resorption and compromised anatomical support for conventional implant placement.

The main diagnoses included complete edentulism of both the maxillary and mandibular arches, with severe bilateral bone loss and sinus pneumatization in the posterior maxilla, moderate bone loss in the mandible, and shallow vestibular depth in both arches. The following treatment options were considered: Option I: Quad zygomatic implants supporting dentures with immediate loading for the maxillary arch and four implants supporting dentures with immediate loading for the mandibular arch. Option II: Conventional upper and lower complete dentures. Options such as bone grafting in the posterior maxilla were discussed but ultimately excluded due to insufficient bone height for implant placement. The final treatment plan was selected on the basis of the patient's preference to avoid extensive surgical procedures and to receive his prostheses within a shorter timeframe. Cone-beam computed tomography (CBCT) (Figure 2) was subsequently performed. Therapeutic interventions involved the placement of quad -zygomatic implants in the maxilla and four endosseous implants in the mandible, all of which were performed via a freehand surgical technique.

Zygomatic implant placement was planned and executed using CBCT imaging to identify key anatomical landmarks ensuring safe and accurate positioning. The infraorbital foramen, pyriform nasal aperture, infraorbital margin, and zygomatico-facial foramen were carefully located to prevent neurovascular or orbital injury. The anterior end of the zygomtic arch and most prominent part of the zygomatic arch were used to define the implant trajectory. The orbital floor depth was measured to maintain a safety margin of at least 2.2 mm. The implant was placed via an intraoral approach from the palatal aspect of the second premolar region. The drilling direction followed the line connecting between the anterior end of the zygomtic arch and most prominent part of the zygomatic arch, with the lateral maxillary wall exposed to guide accurate placement into the zygomatic bone.

Surgical Procedure and Implant Placement

The patient was examined and provided written informed consent upon arrival at the hospital for the surgical procedure. Following nasal intubation, the extraoral area was disinfected with Betadine to reduce the bacterial load and minimize the risk of surgical site contamination. Owing to the absence of a supporting structure to stabilize the surgical template, two bilateral zygomatic implants were planned for freehand procedures. Local anesthesia (2% xylocaine) was administered to the maxilla. A full-thickness flap was raised via a No. 15 scalpel blade, with an incision extending from the right hamular notch to the left, crossing the midline of the alveolar crest. The soft tissues were reflected superiorly to the zygomatico-frontal notch and along the lateral nasal walls. To protect the nasal mucosa during osteotomy preparation, it was reflected

via a periosteal elevator. A pilot drill was used to initiate site preparation to a depth of 25 mm relative to the crest. Osteotomy was then completed to the same depth via sequential drills 2.35 mm and 3.75 mm in diameter. A handpiece-mounted driver was used to place a 45-degree (32.5 mm × 4 mm) Quad-Zygoma implant (Brånemark System Zygoma, Nobel Biocare, Switzerland) into the osteotomy. The implant was gradually threaded into position via the surgical handpiece until the preset torque limit was reached (Figure 3).

To achieve the best possible primary stability, zygomatic implants were implanted during the surgical phase. A recorded insertion torque of 30 N·cm demonstrated adequate mechanical anchoring in the zygomatic bone. The implant length was chosen on the basis of the particular zygomatic architecture of each patient and ranged up to 52 mm. Typically, the platform diameter (at the alveolar crest) was 4.5 mm, and the apical diameter (within the zygoma) was 4.0 mm. Anatomical factors were carefully taken into account when adjusting the angulation of the implant. To ensure engagement with the dense zygomatic bone and avoidance of the maxillary sinus, anterior zygomatic implants were positioned at an angle of 45°, whereas posterior implants were positioned at steeper angles of approximately 70° with respect to the maxillary plane (Figure 4). CBCT was used to assist in preoperative planning, and intraoperative

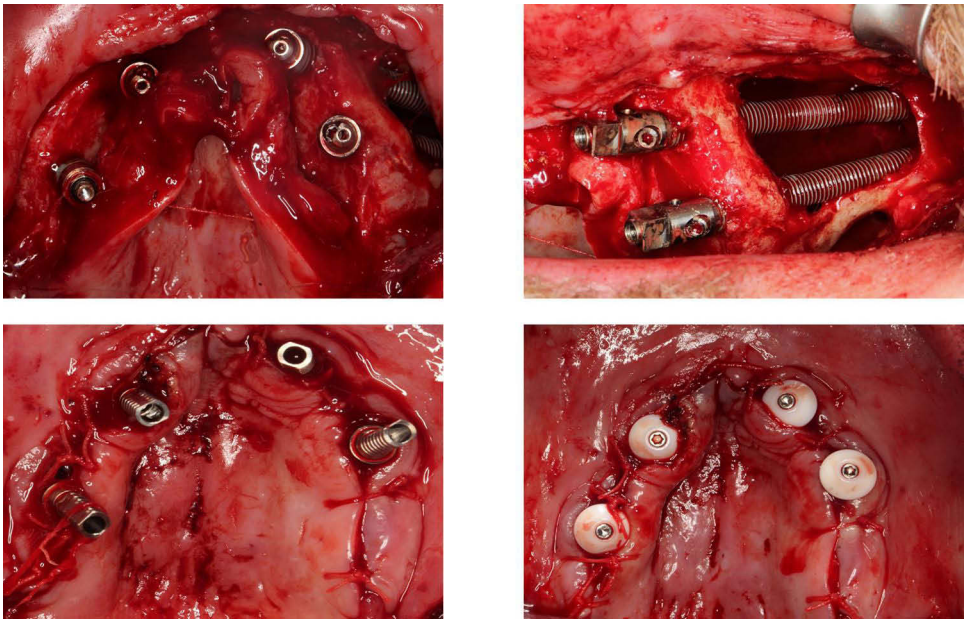

Figure 3 Surgical procedure for insertion and fixation zygomatic implants.

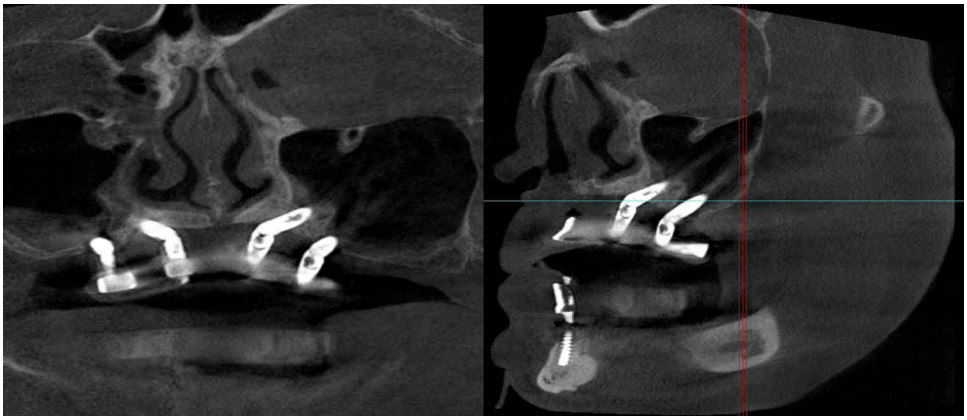

Figure 4 CBCT views showing maxillary zygomatic implant positions in the sagittal and coronal planes.

adjustments were made to the final implant placement in accordance with angulation needs and bone availability. There were no serious surgical side effects, such as orbital floor violation or severe hemorrhage. In this case, there were few sinus membrane perforations, but they had no negative clinical effects.

Prosthetic Procedure

Following the placement of the multiunit abutments (Nobel Zygoma, Nobel Biocare, Switzerland) on the implants, healing caps were positioned, and the surgical sites were carefully sutured. The patient's existing maxillary complete denture was then immediately converted into a fixed prosthesis, which was secured to the four maxillary implants as a screw-retained hybrid restoration. In the mandibular arch, four implants were placed bilaterally between the mental foramina and similarly restored with a screw-retained hybrid prosthesis. Occlusion was thoroughly evaluated and adjusted during the third follow-up visit after prosthesis fabrication to ensure proper function and comfort.

Follow-Up and Outcomes

The patient's function and appearance were restored within 48 hours of implant placement (Figure 5). The prosthesis provided within 48 hours after surgery was a permanently fixed complete denture created to offer immediate functionality and aesthetics during the osseointegration phase. After eight weeks, the patient reported high levels of satisfaction. Periodic evaluations were conducted posttreatment, with an emphasis on maintaining good oral hygiene. Clinical and radiographic assessments were performed more than two years after treatment (Figure 5). Over 24 months of follow-up, the patient experienced no complications and reported high satisfaction with both function and aesthetics.

Discussion

The rehabilitation of patients with severely atrophic maxillae remains a significant clinical challenge, particularly when conventional implant placement is not feasible due to insufficient bone volume. Zygomatic implants provide a graftless

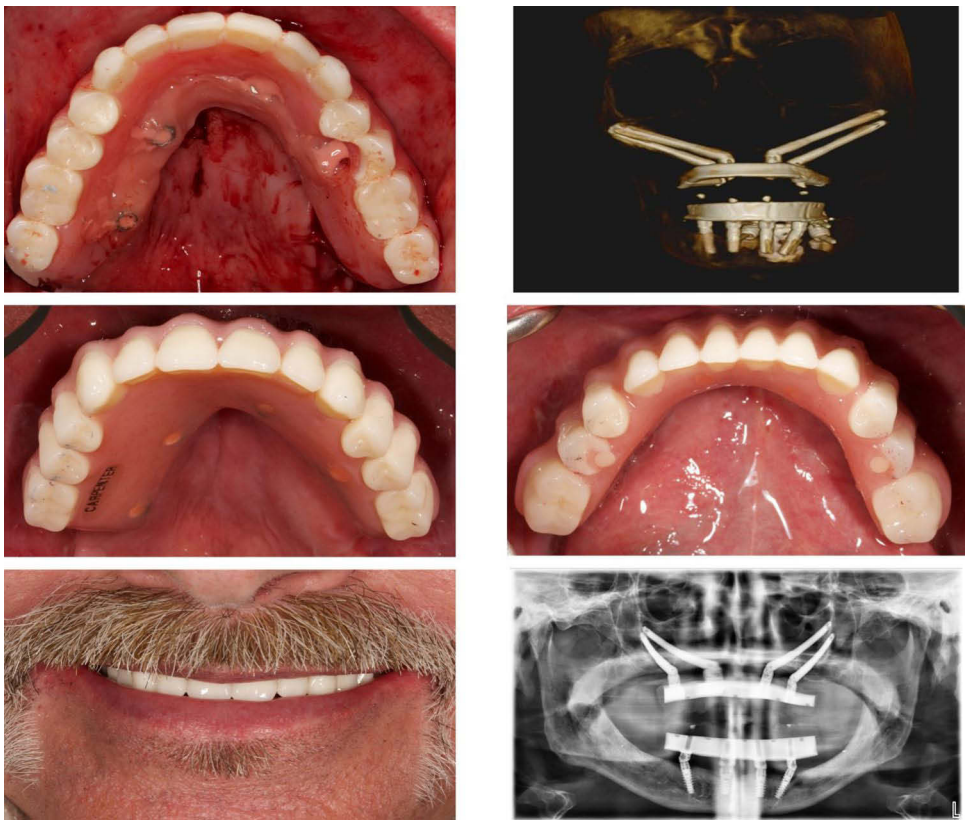

Figure 5 Postoperative clinical photograph shows prosthesis insertion after 48 hours and radiograph follow-up at 24 months.

solution for restoring severely atrophic maxillae, especially in cases where standard implants are contraindicated because of inadequate bone support. Unlike pterygoid implants, which rely on residual tuberosity and pterygoid plate engagement, zygomatic implants achieve anchorage in the dense zygomatic bone, ensuring stability even in cases of advanced posterior maxillary resorption.[15]

Traditionally, autogenous bone grafting and sinus lift (lateral or crestal techniques) have been used to increase bone height for implant placement. However, these procedures frequently need many surgical steps, take longer to recover, and increase the risk of morbidity, especially in older or systemically challenged patients.[16] On the other hand, zygomatic implants, particularly those in a quad-zygomatic configuration, allow for instant loading, reduce the length of therapy, and greatly enhance patient satisfaction and functional results.[17]

In the present case, zygomatic implants were selected because they provide strong anchorage within the zygomatic bone and eliminate the need for extensive grafting procedures, in line with recommendations from earlier studies.[18,19] Recent evidence also supports the long-term clinical reliability of zygomatic implant therapy. A retrospective study reported a 97.7% survival rate for 224 zygomatic implants over a 17-year follow-up period, highlighting the durability of this approach.[20] Similarly, a systematic review and meta-analysis found a pooled survival rate of approximately 98%, with relatively low complication rates; 12% for sinusitis and 11% for implant malposition.[21] These findings affirm the long-term predictability of zygomatic implants when applied using meticulous surgical and prosthetic protocols.

Clinically useful full-mouth rehabilitation cases, like the one described here, provide information about how patients adjust to different masticatory dynamics, occlusal function, and general prosthetic comfort.[22,23] These instances aid in the creation of evidence-based guidelines and the improvement of therapeutic approaches for the treatment of complicated maxillary atrophy. Assessments of residual alveolar bone height, sinus shape, bone density at the zygomatic structure, and general systemic health should be part of the evaluation criteria used during case selection. Additionally, sinus anatomy and any problems can be identified with the use of preoperative imaging techniques like CBCT. Before moving further, it is important to assess the patient's expectations, compliance with oral hygiene, and capacity to adjust to a permanent restoration. To reduce problems such sinusitis, soft-tissue dehiscence, or prosthetic mismatch, predictable results depend on careful patient selection, accurate surgical execution, and organized postoperative follow-up.[20,24,25]

In the present case, sustained implant function and the absence of complications over the follow-up period were guaranteed by meticulous planning, expert surgical treatment, and regular oral hygiene maintenance. Moreover, the hybrid prosthesis used is considered a superior alternative for restoring the function of zygomatic implants. Since occlusal stresses may lead to implant failure and screw loosening, prostheses need to be sufficiently strong to resist deformation and distortion. A hybrid denture prosthesis was selected to reconstruct the maxilla, given the patient's intra-arch distance of approximately 33 mm. Compared with traditional overdentures, hybrid dentures have been shown to provide greater psychological satisfaction and improved masticatory efficiency. These prostheses are also compatible with combinations of angled and axial implants.[26]

The current case showed good clinical results throughout the course of the follow-up period, including high patient satisfaction, optimum prosthetic performance, and adequate primary stability. These findings are in line with earlier research that found zygomatic implant-supported rehabilitations to have good survival rates and long-term success.[26–31] Over follow-up periods of 2.5 to 3 years, several studies have reported success rates ranging from 94% to 96.3%, highlighting the fact that rapid loading techniques may produce reliable, long-lasting effects with little problems. Additionally, zygomatic implants have been demonstrated to improve overall treatment efficiency by increasing patient comfort and lowering the need for subsequent grafting procedures.[26–31] The patient showed no signs of implant failure, peri-implantitis, soft-tissue inflammation, prosthetic framework fracture, screw loosening, or oral hygiene issues during the follow-up period. At every visit, the peri-implant soft tissues were carefully examined, revealing good mucosal conditions free of erythema, dehiscence, or mucositis. In treating severely atrophic maxillae, these results highlight the long-term biological stability, peri-implant tissue health, and general clinical reliability of zygomatic implant–supported rehabilitation.[20,21]

Clinical Implications

Zygomatic implants provide a useful, reliable, and effective therapeutic option for individuals with significant maxillary atrophy who are not good candidates for traditional implants. By avoiding substantial grafting, they drastically cut down on treatment time and morbidity. Nevertheless, the procedure is difficult and necessitates careful patient selection, thorough preoperative preparation, and sufficient surgical skill. Maintaining good dental cleanliness, balanced occlusion, and ongoing monitoring to identify and treat issues early are essential for long-term success.

The present study has several limitations. First, it is important to acknowledge that this research has a narrow focus since it examines only one case report, which may restrict the extent to which the findings can be generalized. Because patients are likely selected using certain clinical or procedural criteria, patient selection bias may exist. Furthermore, the length of follow-up might not be enough to assess long-term results such as implant survival, prosthesis success, and comorbidities. The efficacy and predictability of zygomatic implants in atrophic maxilla rehabilitation require additional long-term research with larger cohorts and randomized controlled trials. The placement of these fixtures must be considered a complex surgical procedure and requires experienced surgeons, considering that important anatomic structures may be involved.

Conclusions

Given the limitations of the study, several conclusions can be drawn. This case report demonstrates the successful rehabilitation of a severely atrophic maxilla via a graftless quad-zygomatic implant approach, achieving immediate functional and aesthetic outcomes without complications over a two-year follow-up. The technique provides a less invasive alternative to traditional grafting, with a reduced recovery time, lower morbidity, and improved patient satisfaction. This case reinforces the reliability and efficiency of quad-zygomatic implants in managing complex edentulous cases, especially when grafting is not desirable. However, the procedure requires advanced surgical skill, careful planning, and consistent follow-up to ensure long-term success.

Data Sharing Statement

The data that support the findings of this study are available within the article.

Consent Statement

Institutional approval was not required for the publication of this retrospective single case report, as it did not involve experimental procedures. Written informed consent for the publication of the case details and accompanying images was obtained from the patient, in accordance with the journal's patient consent policy.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare no conflicts of interest in this work.

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