
Case Report

QUAD ZYGOMATIC IMPLANTS FOR THE MANAGEMENT OF AN IMPROPER MAXILLARY REHABILITATION: A CASE REPORT

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ABSTRACT

Zygomatic implants (ZIs) represent an advanced surgical option for the rehabilitation of patients with severely atrophic maxillae, particularly when conventional implant placement is not feasible because of insufficient bone volume. By engaging the dense cortical bone of the zygoma, these implants can provide high primary stability and support fixed prosthetic rehabilitation in challenging anatomical conditions. Pterygoid implants may provide additional posterior anchorage and further improve implant distribution in complex full-arch rehabilitations. Here, we report a case of inadequate maxillary rehabilitation treated with four zygomatic implants, placed in a quad configuration with two implants on each side, in combination with two pterygoid implants, one on each side. Intraoral welding technique (WT) was used to rigidly splint the implants and provide immediate stabilization of the prosthetic framework. We delivered a provisional maxillary fixed prosthesis on the same day as surgery. At the one-year follow-up, the patient was clinically healthy, with no reported chewing difficulties, aesthetic concerns, or postoperative complications. The combination of quad zygomatic implants, pterygoid implants, and intraoral welding may offer a useful graftless approach for rescuing complex maxillary rehabilitations, allowing immediate fixed prosthetic restoration in carefully selected patients.

KEYWORDS: *maxilla, implant, graft, bone, quad, zygomatic, fixtures*

INTRODUCTION

The development of zygomatic implants (ZIs) represents one of the most significant innovations in oral rehabilitation for patients with severe maxillary atrophy. Their history spans more than three decades and reflects the evolution of implantology from conventional approaches relying on sufficient bone volume to advanced surgical protocols aimed at avoiding extensive grafting procedures. The concept originated in the early 1980s and 1990s as clinicians searched for predictable solutions for patients suffering from maxillary defects due to trauma, oncology, congenital abnormalities, and severe resorption. ZIs ultimately emerged as a graftless, biomechanically stable alternative

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that continues to expand its indications in contemporary practice (1-8).

The earliest documented applications were in oncologic patients, particularly those who had undergone partial or total maxillectomy. In these cases, conventional implants could not be placed because of insufficient residual maxillary bone, and the zygomatic bone offered a strategic anchorage point for prosthetic rehabilitation (9-22).

By the mid-1990s, Brånemark formalized the design of the first generation of ZIs, characterized by their considerable length (typically 30-52.5 mm) and unique apical threads meant to engage the zygoma securely. The original surgical protocol involved an intra-sinus approach, in which the implant traversed the maxillary sinus and emerged in the posterior region of the palate, providing posterior support for fixed prostheses. Early clinical results demonstrated high survival rates and functional stability, encouraging broader adoption (1, 2).

The transition from use in oncologic and trauma-related cases to application in severely atrophic edentulous maxillae began in the late 1990s and early 2000s. This marked a major shift: zygomatic implants were no longer limited to reconstructive cases but became an alternative to extensive bone grafting procedures such as sinus lifts, Le Fort osteotomies, and iliac crest grafts. As clinicians observed the significant morbidity, long healing periods, and variable outcomes associated with grafting, the appeal of a graftless solution that could support immediate or early loading increased (1, 6-8, 19, 20).

A pivotal milestone was the introduction and refinement of the Brånemark Zygo Concept, which standardized surgical guidelines, implant positioning, and prosthetic protocols. Multicenter clinical studies supported the concept, reporting survival rates consistently above 95%, even over long-term follow-ups. This established ZIs as a predictable option for full-arch rehabilitation in challenging anatomical conditions (1, 7, 8, 19, 20).

In the 2000s, further advancements took place as clinicians sought to reduce complications associated with the intra-sinus trajectory, such as sinusitis, oro-sinusal fistulae, and prosthetic emergence issues. This led to variations in implant placement paths, including the extra-sinus (or extra-maxillary) approach, popularized by Aparicio and colleagues (8). In this technique, the implant bypasses the sinus entirely and is placed along the lateral surface of the maxilla, emerging in a more prosthetically favorable position on the alveolar crest. The extra-sinus approach improved hygiene, reduced palatal cantilevering, and facilitated more natural prosthetic designs (3-5, 20).

Refinements in surgical methods were accompanied by improvements in implant design. Newer ZIs featured modified surface treatments to enhance osseointegration, changes in thread geometry to improve stability, and angulated platform designs that enabled better prosthetic alignment. The introduction of immediate loading protocols further enhanced patient acceptance, allowing many to receive fixed provisional prostheses within 24-48 hours of surgery (6, 19, 20).

In recent years, digital technologies have profoundly influenced the field. 3D imaging, virtual planning, and computer-guided surgery now allow clinicians to assess zygomatic anatomy with unprecedented precision, plan implant trajectories, and even utilize patient-specific surgical guides. These technologies have expanded the predictability of ZI placement and reduced surgical risks. Additionally, researchers are studying augmented reality systems and custom surgical navigation tools to further improve accuracy.

Contemporary indications for ZIs continue to expand. In addition to severe maxillary resorption and oncology patients, they are now used in cases of chronic sinus pathology, failed implant treatments, and patients seeking immediate full-arch rehabilitation with minimal surgical morbidity (20, 22). The "Quad-zygoma" configuration (placement of two zygomatic implants per side) has emerged as a robust solution for individuals with extremely limited anterior bone volume (18, 20).

Pterygoid implants represent an additional graftless option for obtaining posterior anchorage in patients with reduced maxillary bone availability. Their use may provide distal support for full-arch prosthetic rehabilitation and can be combined with other advanced implant strategies in complex maxillary cases (16).

In selected patients, the combination of pterygoid and zygomatic implants may provide a broader anteroposterior distribution of implant support, which is particularly useful in complex full-arch rehabilitations (16).

In the present case, an improper maxillary rehabilitation was managed using four zygomatic implants in a quad configuration, two pterygoid implants, and intraoral welding.

CASE REPORT

In April 2025, a 68-year-old male non-smoker was referred to our clinic with difficulty chewing. Clinical examination revealed an inadequate maxillary Toronto-type fixed rehabilitation associated with a Class III occlusal relationship and bilateral crossbite. CBCT examination showed four implants in the maxilla: two zygomatic implants and two conventional implants placed in the premaxillary region (Fig. 1).

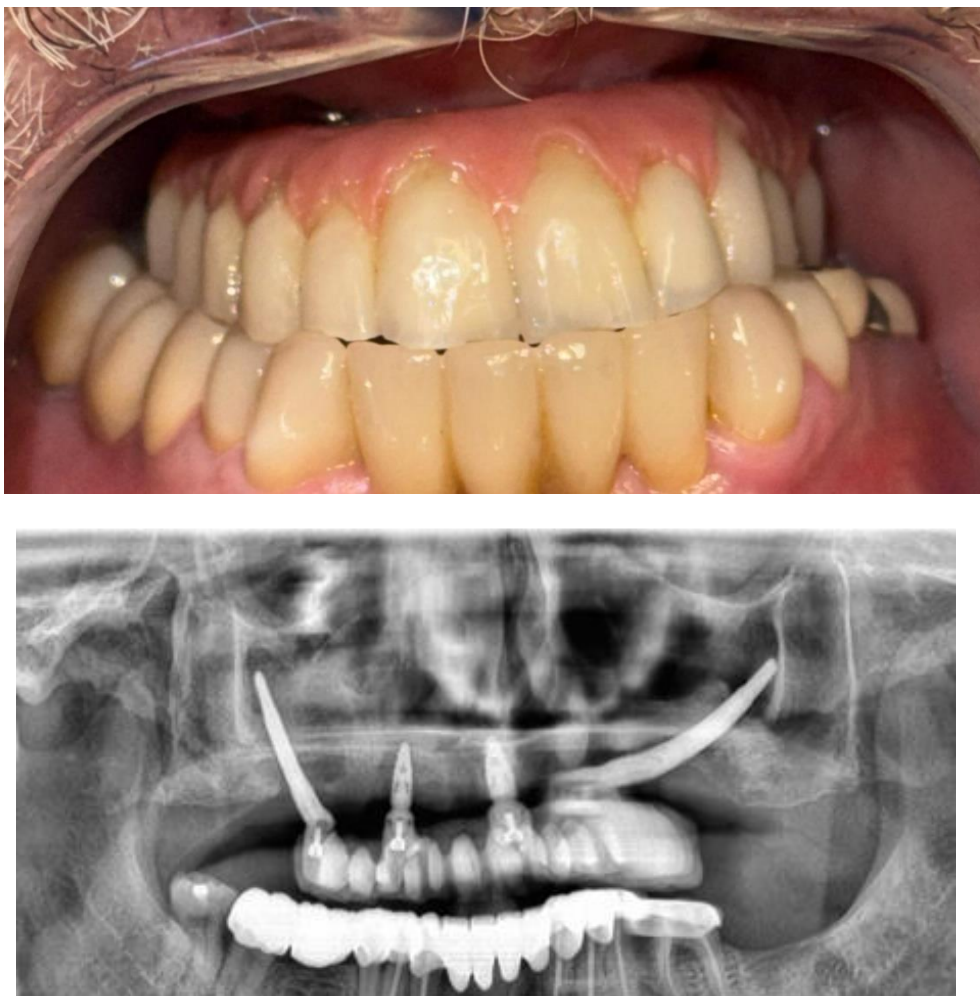


Fig. 1. *Pre-treatment X-ray and photos.*

Before surgery, the patient was informed of the operative risks and complications, and written consent was obtained for publication of this case report and accompanying images. The treatment objective was a fixed full-arch reconstruction without staged major bone grafting.

Surgically, under general sedation and after local anesthesia, the surgical field was prepared with intraoral access via a slightly palatal incision. A full-thickness flap was elevated to expose the lateral wall of the maxilla and the zygomatic buttress. Previously placed implants were removed. A lateral antrostomy was performed to visualize the maxillary sinus and control the drill's trajectory. The osteotomy was initiated at the maxillary alveolar crest, typically in the premolar region, and directed cranially and laterally toward the body of the zygoma (1-5, 18).

Progressive drilling was carried out with long, specifically designed drills following the predetermined angulation, taking care to protect adjacent structures such as the orbit, infraorbital nerve, and sinus membrane. Once the osteotomy reached the dense zygomatic bone, 40 mm implants were inserted, engaging the zygomatic bone for bicortical stabilization. "Quad zygoma" configuration was used (18). Soft-tissue closure was performed with careful flap repositioning to accommodate the prosthetic emergence profile and avoid tension (Fig. 2, 3).

A total of four zygomatic implants were placed, with two implants on each side, in combination with two pterygoid implants, one on each side.

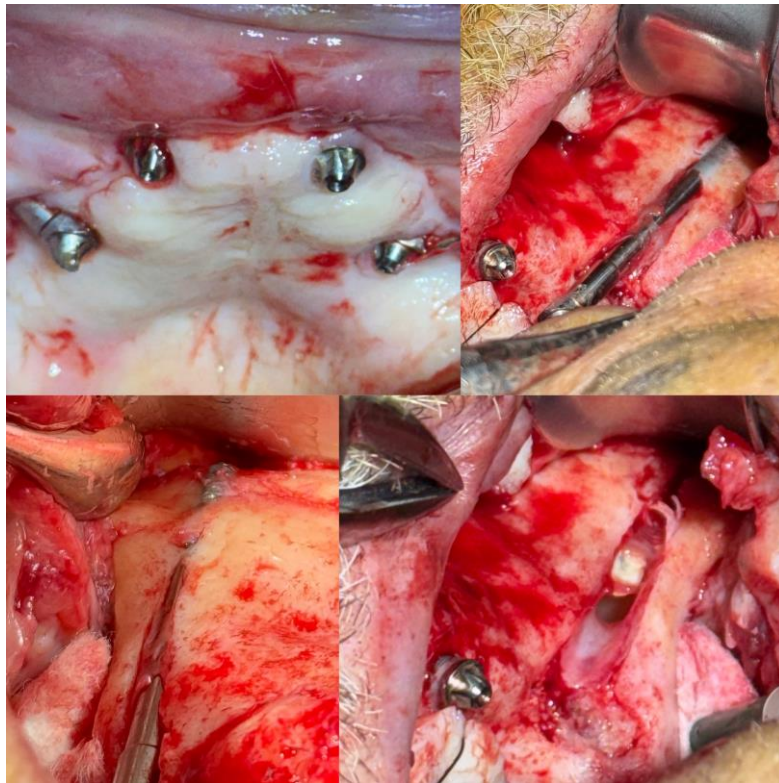


Fig. 2. Intraoperative sequence. Clinical views show exposure of the severely resorbed maxilla, preparation of long implant osteotomies, and placement of angled implants/abutments.

Soft-tissue management represented a fundamental and, arguably, one of the most technically demanding aspects of the surgical procedure. First, a buccal fat pad (Bichat's fat pad) flap was mobilized to assist soft-tissue closure and provide additional tissue coverage. Particular attention was then required to achieve an adequate peri-implant soft-tissue configuration and a favorable prosthetic emergence profile. To accomplish this, the keratinized palatal mucosa was extensively mobilized and repositioned approximately 10 mm toward the buccal aspect, allowing the keratinized tissue to be transferred from the palatal to the vestibular side of the rehabilitation (Fig. 3).

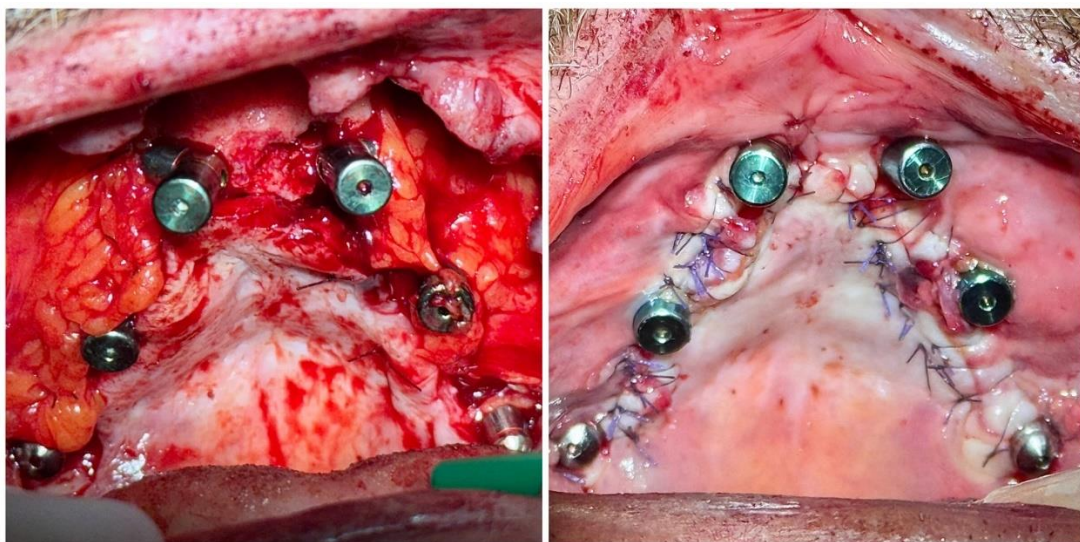


Fig. 3. A Bichat's fat pad flap was used to assist soft-tissue closure. The keratinized palatal mucosa was extensively mobilized and advanced approximately 10 mm toward the buccal aspect to reposition the soft tissue adequately around the implant emergence sites.

Then welding technique (WT) was used. WT is based on the principle that splinting implants together at the time of surgery dramatically reduces micromovements, helping maintain implant stability during the critical early phases of osseointegration (Fig. 4). By creating a single rigid structure, the forces generated during mastication are distributed across the entire framework rather than concentrated on individual implants, thus minimizing the risk of failure (17).

The workflow begins with implant placement according to the prosthetic plan. After implant placement, titanium abutments or transmucosal components are connected. A prefabricated or chairside-crafted titanium bar is then adapted to connect the abutments. Using a specialized intraoral welding unit, an electric arc precisely fuses the titanium components, achieving an instantaneous, highly stable rigid connection. Because the weld is performed directly on the definitive implant abutments, there is no need for laboratory soldering steps or delayed framework fabrication (17).

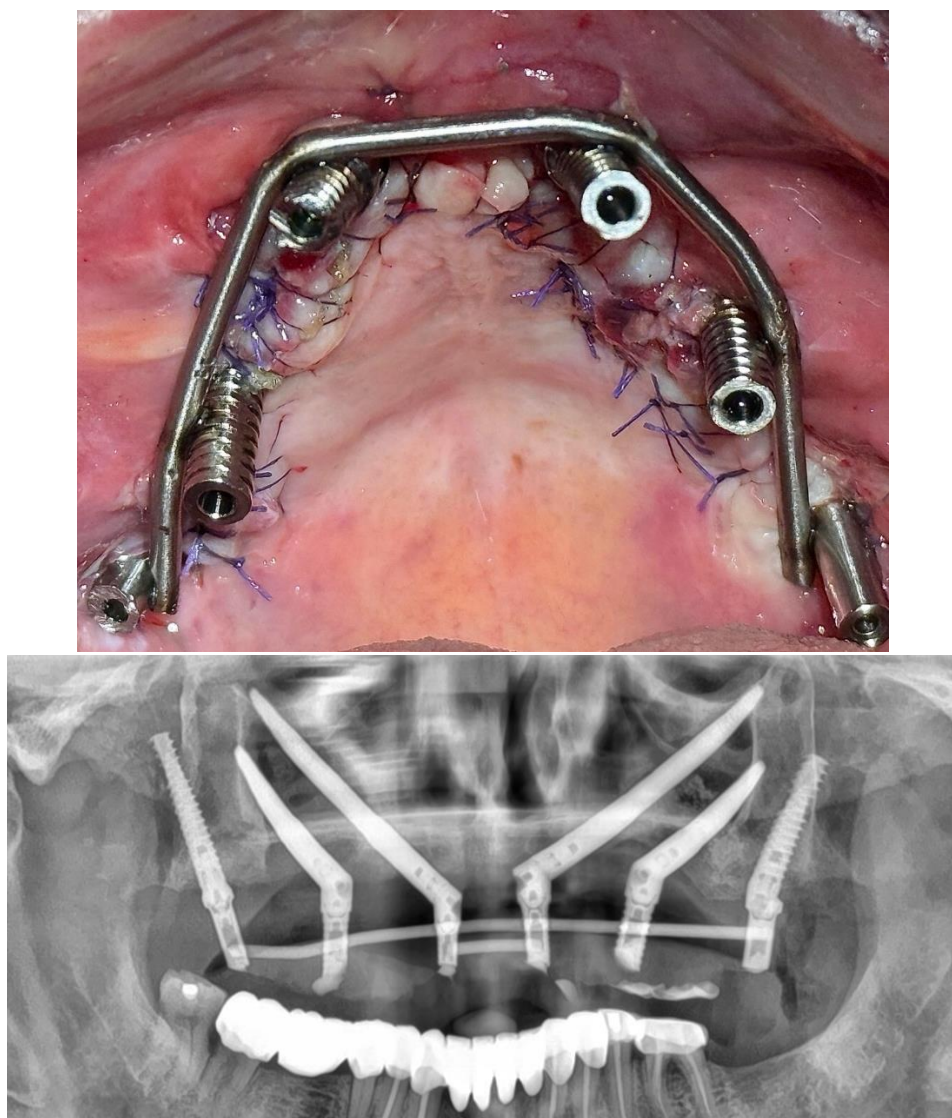


Fig. 4. Panoramic radiograph and the welded structure (WT).

After welding, the bar is adjusted as needed and refined and polished in situ. Composite or acrylic material was then layered onto the framework to create an immediate provisional prosthesis, which was delivered to the patient on the same day (Fig. 5). The rigidly welded structure protects the implants from excessive loading and stabilizes the prosthesis in cases of compromised bone quality or reduced primary stability (17).



Fig. 5. *Prosthetic components. Occlusal and frontal views of the screw-retained maxillary restorations. On the right, the old prosthesis; on the left, the new one.*

Clinical advantages of the welding technique include predictability, reduced treatment time, enhanced stability in immediate loading, and a minimally invasive overall approach. It is particularly beneficial for edentulous arches, severely atrophic ridges, and elderly or medically compromised patients who may not be candidates for complex grafting procedures. Potential complications are rare and typically related to improper welding technique or inadequate prosthetic planning (17).

Postoperative management included antibiotics, anti-inflammatories, and sinus precautions. No complications, such as sinusitis, soft-tissue irritation, or prosthetic misalignment, were recorded after surgery. The patient remained clinically healthy at the one-year follow-up. The following images show the prosthetic and radiographic differences (Fig. 6, 7, 8).



Fig. 6. Clinical comparison of the maxillary rehabilitation. The upper panel shows the pretreatment condition, whereas the lower panel shows the postoperative fixed full-arch rehabilitation.

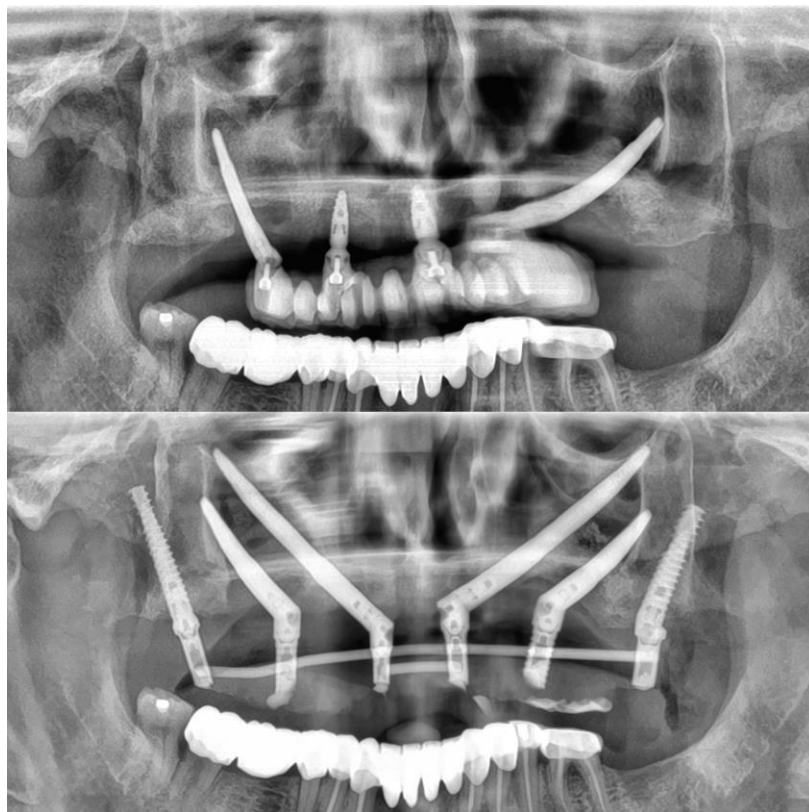


Fig. 7. Panoramic radiographic comparison. The upper panel shows the initial maxillary implant-supported condition; the lower image demonstrates the postoperative distribution of multiple implants supporting a maxillary cross-arch prosthesis.



Fig. 8. *Definitive clinical outcome. (A): Occlusal view of the maxillary fixed prosthesis and implant access channels; (B): Frontal intraoral view of the maxillary and mandibular dentitions; (C): Cropped smile view.*

DISCUSSION

This case combines several advanced graftless concepts in a single bimaxillary rehabilitation. In the maxilla, the four zygomatic implants provide bilateral remote anchorage when the residual alveolar process is inadequate, while the two pterygoid implants extend the posterior support. Tomaselli's clinical reports specifically address quad-zygomatic configurations and pterygoid implants, while intra-oral welding has been described as an adjunct for immediate rigid splinting (16-18).

A range of advanced implant and regenerative surgical approaches has been described for the management of complex alveolar deficiencies and implant-supported rehabilitation (9-18). Over the past decade, the literature on ZIs has matured to include multiple systematic reviews and meta-analyses. Recent high-quality evidence indicates that zygomatic implants provide a reliable graftless option for full-arch rehabilitation, offering high survival rates, acceptable complication profiles, and positive patient outcomes, particularly when placed by experienced clinicians following rigorous protocols (7, 8, 19, 20).

One of the most comprehensive recent meta-analyses was reported by Brennand Roper et al (19), which included 18 clinical studies with a minimum follow-up of 3 years. This analysis pooled data from 623 patients and 1349 zygomatic implants to estimate long-term treatment outcomes. The mean survival rate of ZIs was 96.2% at an average follow-up of 75.4 months (~6.3 years), demonstrating durability comparable to conventional implants used in non-atrophic jaws. Implant success, defined as survival without biological or neurologic complications, was similarly high (~95.7%). Prosthesis survival was 94%, and patient-reported outcomes indicated improved satisfaction following rehabilitation with ZIs. Among biological complications, sinusitis had the highest prevalence (~14%), although most cases were manageable with medical or minor surgical intervention (19).

A consensus report by the International Team for Implantology (ITI) based on this meta-analysis also highlighted immediate loading protocols as associated with higher survival rates (98.1%) compared to delayed loading (95%) when adequate primary stability was achieved. These findings support the clinical viability of early functional restoration with fixed prostheses in selected cases (20).

Although not a pure meta-analysis limited to ZIs alone, comparative evidence supports that ZIs perform similarly to standard implants in terms of survival. Several systematic reviews, including data from randomized controlled trials and observational studies, suggest that ZIs provide survival rates that are statistically comparable to conventional implants placed in grafted or sinus-lifted maxillae. These findings reinforce the suitability of ZIs as an alternative to extensive bone grafting procedures, with similar long-term stability and function (7, 8, 19, 20).

A recent protocol has also proposed a systematic review and network meta-analysis to further compare the effectiveness of zygomatic-implant fixed rehabilitation for the atrophic edentulous maxilla (21). Systematic review and consensus evidence support ZIs as an alternative to grafting procedures, with the potential to reduce overall treatment time and patient morbidity and to allow immediate function in selected cases (7, 8, 19, 20).

Soft-tissue management represented a critical component of the present rehabilitation and was among the most technically demanding phases of the procedure. In zygomatic implant therapy, inadequate peri-implant soft-tissue conditions may contribute to mucositis, dehiscence, hygiene difficulties, and long-term maintenance problems (7, 8, 19, 20). In the present case, a buccal fat pad (Bichat's fat pad) flap was mobilized to provide additional tissue coverage and facilitate tension-free primary closure. Subsequently, the keratinized palatal mucosa was advanced approximately 10 mm toward the buccal aspect in order to improve the peri-implant soft-tissue configuration and the prosthetic emergence profile. Achieving stable primary closure was considered essential to protect the surgical site and promote uneventful

healing.

Meta-analyses in recent years have consolidated data on the incidence of complications associated with ZIs. Sinusitis is the most frequently encountered biological complication, with prevalence varying across studies but consistently highlighted in aggregated analyses. Soft-tissue challenges, including mucositis or dehiscence at implant emergence sites, are the second issue that can affect hygiene and long-term maintenance. Prosthetic complications, including framework or veneering material fracture, screw or abutment loosening or fracture, and loss of prosthetic components, are a third issue. Meta-analytical data show these events occur but at manageable rates when appropriate prosthetic protocols are followed (7, 8, 19, 20). A five-year complication analysis and the later series of 274 zygomatic implants with a mean 7.5-year follow-up reinforce the need for long-term clinical, radiographic, sinus and prosthetic surveillance (23, 24).

Although zygomatic implant complications such as sinus involvement and prosthetic maintenance require vigilance, the majority are not catastrophic and can be successfully treated with appropriate interdisciplinary care (7, 8, 19, 20). Here, we report a case of improper maxillary rehabilitation in which a quad-zygomatic implant configuration combined with pterygoid implants was used as a rescue treatment.

Pterygoid implants provided additional posterior anchorage and complemented the bilateral support achieved with the quad-zygomatic configuration. This combined graftless approach allowed implant support to be extended toward the posterior maxilla without resorting to major bone augmentation procedures (16).

Although pterygoid implants can provide valuable posterior support in severely atrophic maxillae, their placement is technically demanding because of the anatomical complexity of the pterygomaxillary region. Potential complications may be related to surgical access, bleeding, incorrect implant positioning, or involvement of adjacent anatomical structures; therefore, accurate three-dimensional planning and surgical experience are essential (16).

Thanks to the exceptional primary stability achieved, immediate loading was performed. A fixed provisional prosthesis can often be delivered the same day of operation, restoring both function and aesthetics (6, 17, 18, 20).

CONCLUSIONS

ZI technique provides a predictable solution for full-arch rehabilitation in patients with advanced maxillary atrophy, significantly reducing treatment time while improving patient quality of life (19, 20).

Beyond implant positioning and primary stability, careful soft-tissue management is key in complex zygomatic implant rehabilitation (7, 8, 19, 20). In this case, a buccal fat pad flap, vestibular repositioning of the keratinized mucosa, and tension-free primary closure helped achieve adequate tissue coverage and a favorable peri-implant environment.

WT provides additional rigid splinting of the implants and may contribute to stabilization during immediate loading (17). Consequently, an immediate provisional upper jaw prosthesis was delivered the same day of operation.

Within the limitations of a single case report, the clinical and radiographic findings support the feasibility of this combined treatment strategy. The procedure should be reserved for carefully selected patients and performed by an experienced multidisciplinary team. Accurate three-dimensional planning, prosthetically driven implant placement, comprehensive informed consent, passive framework fit, and long-term neurosensory, sinus, radiographic, and prosthetic maintenance are essential. Larger prospective studies with standardized clinical and patient-reported outcome measures are required to determine the long-term predictability and safety of this approach.

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