
Case Report

BIMAXILLARY IMPLANT-PROSTHETIC REHABILITATION IN SEVERE BONE ATROPHY USING ZYGOMATIC AND PTERYGOID IMPLANTS AND BILATERAL INFERIOR ALVEOLAR NERVE TRANSPOSITION

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ABSTRACT

Severe bimaxillary atrophy may preclude conventional implant placement because of maxillary sinus pneumatization, limited residual alveolar bone and the superficial course of the inferior alveolar nerves. Remote cortical anchorage and nerve-repositioning procedures may provide an alternative in carefully selected patients. An adult patient with terminal dentition and advanced bimaxillary bone deficiency underwent full-arch rehabilitation. The maxilla was treated with four zygomatic implants and two pterygoid implants. The mandible was treated by bilateral inferior alveolar nerve transposition, followed by placement of four implants in the interforaminal region and two posterior implants in the gonial regions. The mandibular implants were rigidly connected by an intraorally welded titanium framework. Retained full-arch overdenture prostheses were delivered, and postoperative radiographic and clinical documentation demonstrated the intended broad anteroposterior implant distribution and restoration of occlusion and smile. The combination of quad zygomatic and bilateral pterygoid anchorage in the maxilla, with bilateral nerve transposition, interforaminal implants, and gonial implants in the mandible, can provide an extensive supporting polygon in extreme bimaxillary atrophy. The approach is highly technique-sensitive and requires advanced anatomical knowledge, comprehensive consent, neurosensory and sinus surveillance, passive prosthetic fit, and long-term maintenance.

KEYWORDS: *maxillary atrophy, zygomatic implants, pterygoid implants, inferior alveolar nerve transposition, gonial region, full-arch implant rehabilitation*

INTRODUCTION

Pre-maxilla atrophy is a condition characterized by the loss of bone volume in the anterior maxillary region, presenting a significant challenge in implant dentistry. The primary cause often stems from the loss of natural teeth, leading to the resorption of alveolar bone in the pre-maxillary area. Chronic periodontal disease can contribute to bone loss, affecting the stability and volume of the maxillary bone. Advanced maxillary and mandibular resorption can make conventional implant rehabilitation impossible without extensive augmentation. In the maxilla, loss of alveolar height and width is often compounded by sinus pneumatization. In the posterior mandible, the residual crest may lie immediately above the inferior alveolar canal, preventing placement of implants of useful length without nerve-related risk. Graftless strategies seek primary stability in remote cortical structures and aim to shorten treatment while avoiding the morbidity of large reconstructive grafts (1).

Zygomatic implants obtain anchorage in the body of the zygoma and are used for severe maxillary atrophy, failed grafts and selected maxillary defects. When the anterior maxilla is also inadequate, four zygomatic implants - two on each side - may provide complete maxillary support in a quad-zygomatic configuration (2-8).

Long-term series confirm high implant survival, although sinus, soft-tissue, and prosthetic complications remain clinically relevant (9, 10).

CBCT imaging is essential for evaluating anatomy, bone density, and nerve proximity, aiding in meticulous preoperative planning. Because of its proximity to the oral cavity, infection control is paramount. Strict adherence to aseptic techniques and appropriate postoperative care protocols are implemented to minimize the risk of complications. The potential for postoperative hematoma and swelling is mitigated through meticulous hemostasis and appropriate postoperative measures.

Pterygoid implants engage the posterior maxillary complex and increase anteroposterior spread without sinus grafting. Their placement is anatomically demanding because implant trajectory must traverse the tuberosity-pyramidal-ptyergoid corridor while avoiding adjacent neurovascular structures (11-16).

In severely atrophic posterior mandibles, inferior alveolar nerve lateralization or transposition may permit implant placement within basal bone. Tomaselli described the procedure and evaluated it in systematic reviews and clinical series, but temporary or permanent neurosensory disturbance remains the principal concern (17-25). When immediate loading is selected, intraoral welding can create immediate rigid cross-arch stabilization by joining implant abutments to a titanium bar (26).

In recent years, intraoral welding technique (IOWT) has been introduced to enable immediate implant loading and convert a removable denture into a temporary full-arch rehabilitation. It is an evolutionary solution for implant-supported dentures in terms of function and cost. IOWT allows rigid connections immediately after implant insertion by welding a titanium bar between the abutments. The removable denture is adapted to the patient's oral cavity according to height, chewing, and speech habits. The titanium framework is immersed in the denture's inner part with resin. Finally, the abutments are unscrewed, the dentures are removed, polished, and screwed back onto the implants. This approach allows immediate delivery of a full-arch rehabilitation after free-hand implant placement and converts the patient's removable denture into a temporary full-arch rehabilitation.

This report describes a combined bimaxillary approach consisting of four zygomatic and two pterygoid implants in the maxilla and bilateral inferior alveolar nerve transposition with four interforaminal and two gonial implants in the mandible. The clinical sequence is documented with preoperative, intraoperative, postoperative radiographic and prosthetic photographs.

CASE REPORT

An adult patient presented with a compromised terminal dentition and requested fixed bimaxillary rehabilitation. The available panoramic X-ray and CBCT examination demonstrated marked loss of posterior alveolar support in both jaws, extensive maxillary sinus pneumatization, and limited vertical bone above the mandibular canals. Before surgery, the patient was informed about the operative risks and complications, and written consent was obtained from the patient for publication of this case report and accompanying images. The treatment objective was a fixed full-arch reconstruction without staged major bone grafting (Fig. 1).



Fig. 1: Preoperative panoramic radiograph.

Cone-beam computed tomography was used to evaluate zygomatic bone volume, sinus anatomy, the pterygomaxillary corridors, the course of both mandibular canals, the mental foramina, the thickness of the mandibular body, and the geometry of the gonial regions. Planning was prosthetically driven and sought to obtain the widest feasible supporting polygon while maintaining emergence positions compatible with a full-arch prosthesis. The planned distribution comprised six maxillary and six mandibular implants: maxilla: four zygomatic implants (two per side) and two pterygoid implants (one per side); mandible: four interforaminal implants and two posterior implants placed bilaterally at the mandibular angles after nerve transposition; prosthetic strategy: immediate rigid cross-arch stabilization when adequate primary stability was obtained.

After local anesthesia with articaine, a full-thickness flap was elevated in the right posterior mandible. We prepared a lateral cortical access to expose the inferior alveolar canal.

A key feature of this rehabilitation was bilateral repositioning of the inferior alveolar nerves, enabling posterior implant placement in anatomical regions that would otherwise have been inaccessible due to extreme vertical mandibular atrophy (17-25).

The inferior alveolar neurovascular bundle was exposed under direct visualization and delicately released from its anatomical course within the mandibular canal. After careful mobilization and lateral transposition, the bundle was temporarily secured to the vestibular mucoperiosteal flap with fine sutures, keeping it protected and tension-free during preparation of the posterior osteotomy and placement of the gonial implant.

Bilateral inferior alveolar nerve transposition allowed the placement of gonial implants distal to the conventional interforaminal implant zone, markedly increasing the anteroposterior spread of the mandibular supporting polygon and reducing dependence on distal cantilevers (17-25).

The bilateral nature of the nerve-repositioning procedure considerably increased the surgical complexity of the mandibular rehabilitation and required meticulous atraumatic dissection, controlled mobilization, and tension-free protection of both neurovascular bundles (17-25).

Following implant insertion, the residual peri-implant and lateral cortical defect was grafted with Bio-Oss bone substitute. A resorbable membrane was then placed over the grafted area and stabilized with fixation pins. The neurovascular bundle was finally checked to confirm the absence of traction, compression, or direct contact with the implant surface (Fig. 2). This surgical sequence is consistent with the principles described for inferior alveolar nerve transposition in severely atrophic posterior mandibles (17-25).

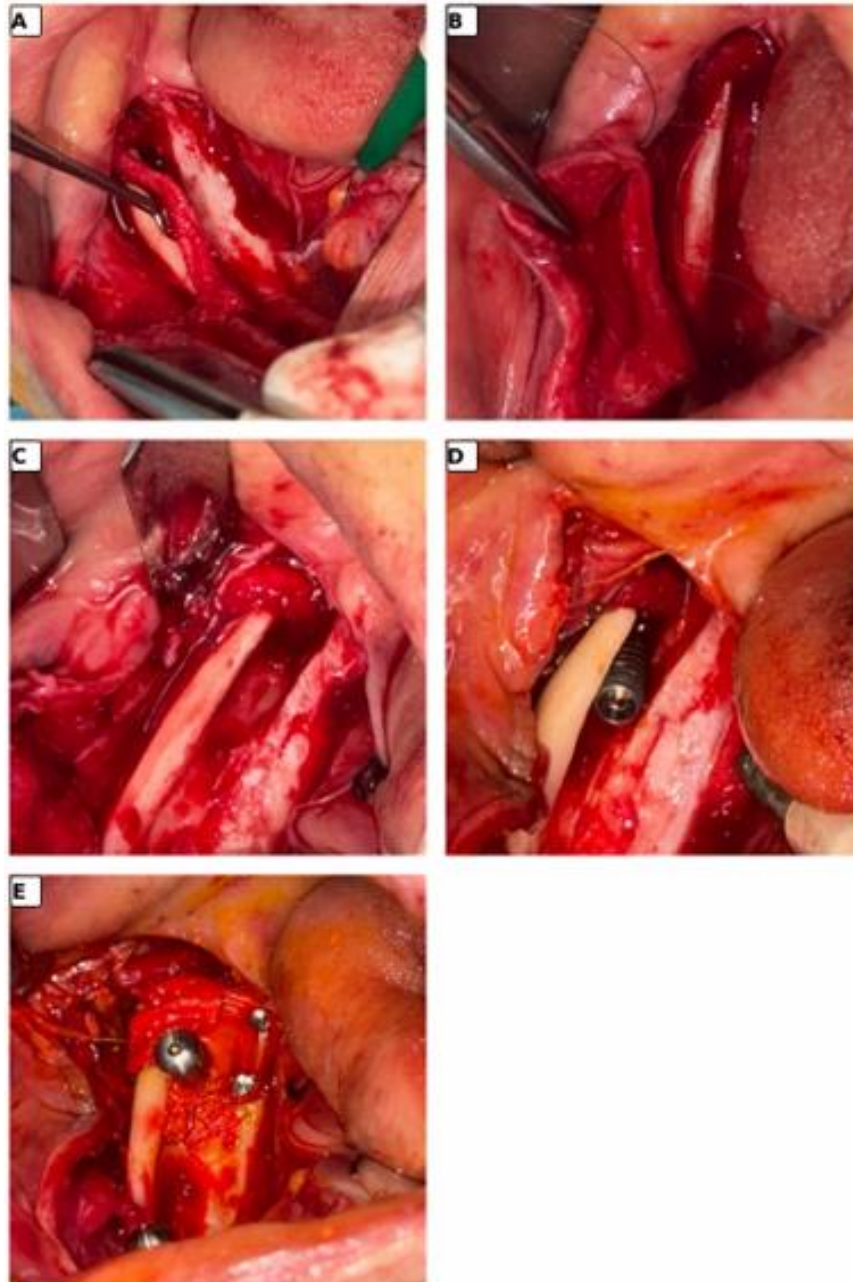


Fig. 2. Right inferior alveolar nerve transposition. (A) Lateral cortical access and identification of the canal. (B) Mobilization of the inferior alveolar neurovascular bundle. (C) Tension-free transposition and protection of the nerve. (D) Implant placement toward the gonial region with the nerve held away from the osteotomy. (E) Reconstruction of the lateral access area after implant insertion with Bio-Oss bone substitute and a resorbable membrane.

The contralateral procedure was performed according to the same anatomical and microsurgical principles. The left inferior alveolar neurovascular bundle was exposed and carefully released from its anatomical course within the mandibular canal. After gentle mobilization and lateral transposition, the bundle was temporarily secured to the vestibular mucoperiosteal flap with fine sutures to maintain a protected and tension-free position during preparation of the posterior osteotomy and placement of the gonial implant. Following implant insertion, the residual peri-implant and lateral cortical defect was grafted with Bio-Oss bone substitute. A resorbable membrane was then positioned over the grafted area and stabilized with fixation pins. The neurovascular bundle was finally checked to ensure the absence of tension, compression, or direct contact with the implant surface (Fig. 3). Bilateral inferior alveolar nerve transposition requires meticulous surgical technique and comprehensive preoperative counselling regarding the risk of temporary or permanent neurosensory disturbances (18-23).



Fig. 3. Left inferior alveolar nerve transposition. (A) Lateral cortical access and canal identification. (B) Mobilization of the inferior alveolar neurovascular bundle. (C) Tension-free transposition and protection of the nerve. (D) Implant placement toward the gonial region with the nerve held away from the osteotomy. (E) Reconstruction of the lateral access area after implant insertion with Bio-Oss bone substitute and a resorbable membrane.

Four implants were placed in the interforaminal region, respecting the mental foramina and potential anterior loops. Together with the bilateral gonial implants, they created a six-implant mandibular configuration with an extended anteroposterior spread. The implants were rigidly splinted by intraoral welding of a titanium bar to the implant abutments (Fig. 4), following the rationale described by Tomaselli for immediate full-arch stabilization intra-oral welding technique (IOWT) (26).

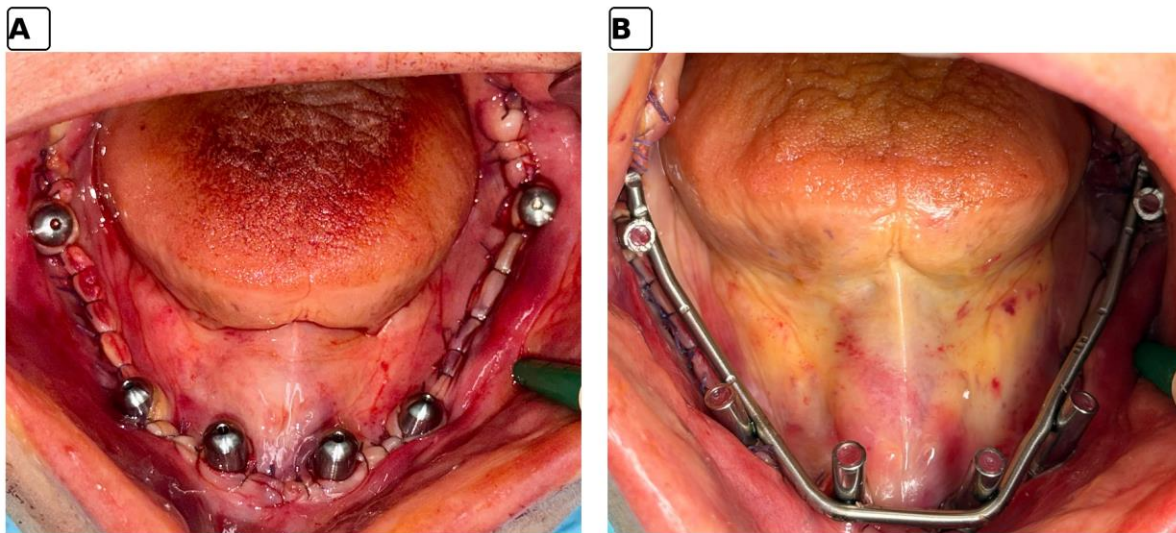


Fig. 4. Mandibular implant distribution and immediate stabilization. (A) Four interforaminal implants and two posterior gonial implants after bilateral nerve transposition and closure. (B) Intraorally welded titanium framework providing rigid cross-arch connection of the six mandibular implants.

The maxillary flap provided broad visualization of the residual ridge, lateral maxillary walls and zygomatic buttresses. We placed four zygomatic implants, with anterior and posterior trajectories on each side. This quad-zygomatic distribution was selected because conventional anterior maxillary support was considered insufficient. Each trajectory was planned to maximize zygomatic bone engagement while maintaining a prosthetically manageable platform position (2-8, 27).

One pterygoid implant was placed on each side to extend support distally. Pterygoid anchorage can reduce distal cantilever length and bypass the pneumatized posterior maxilla, but it requires precise control of entry point, angulation and depth (11-16). The final maxillary configuration therefore comprised six remote-anchorage implants: four zygomatic and two pterygoid implants (Fig. 5).

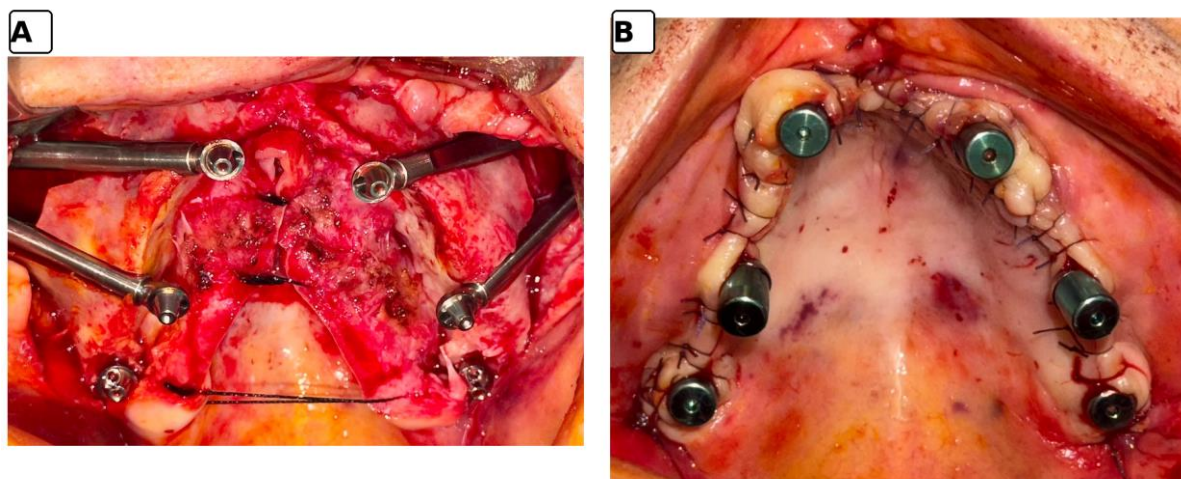


Fig. 5. Maxillary graftless rehabilitation. (A) Intraoperative view of four zygomatic and two pterygoid implants with prosthetic abutments. (B) Occlusal view after soft-tissue closure, demonstrating the bilateral distribution of the six maxillary implant platforms

The broad maxillary and mandibular distributions were designed to limit distal cantilevers, increase resistance to rotational forces, and permit rigid full-arch stabilization. A passive, clinically acceptable framework fit and controlled occlusal contacts were essential because the implants occupied widely separated anatomical regions. Postoperative panoramic and CBCT images confirmed the planned implant pattern: two zygomatic and one pterygoid implant per maxillary side, four anterior mandibular implants and bilateral posterior implants at the angles of the mandible (Fig. 6). Titanium pins were positioned to create tension and stability of resorbable membranes that contain bone grafts. Mucosa was sutured by primary intention, and then intraoral welding was performed.

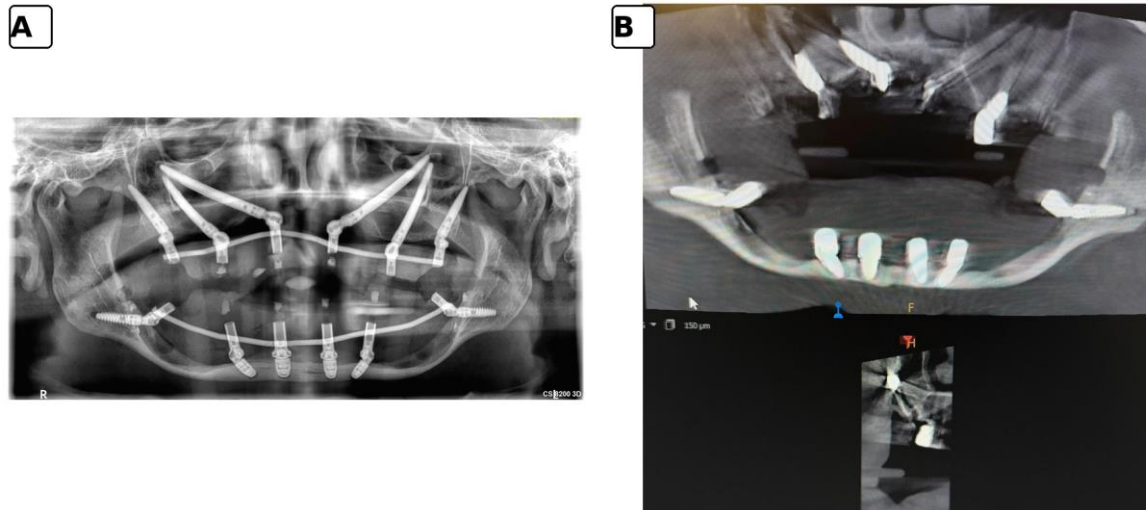


Fig. 6. Postoperative radiographic assessment. (A) Anonymized panoramic radiograph showing four zygomatic implants, two pterygoid implants, four interforaminal implants, bilateral gonial implants and the rigid cross-arch frameworks. (B) Postoperative CBCT reconstruction illustrating the posterior mandibular implants and their relationship with the mandibular body and angle.

The clinical photographs document the delivery of a removable, implant-supported, bar-retained full-arch overdenture. The supporting bar was rigidly connected to the implant abutments using intraoral welding, restoring occlusal relationships, function, and smile aesthetics (Fig. 7).

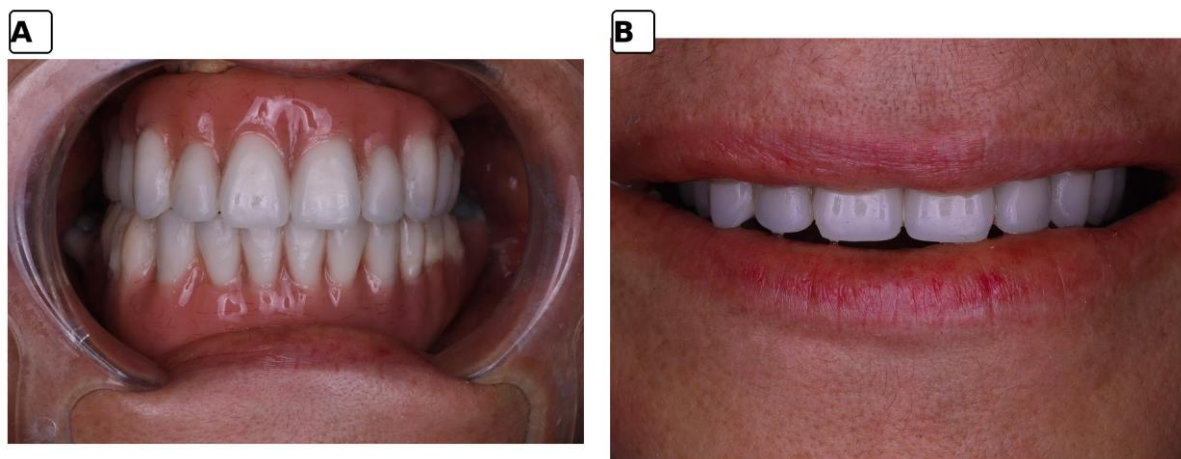


Fig. 7: Clinical prosthetic outcome. (A) Frontal intraoral view of the bimaxillary full-arch rehabilitation in occlusion. (B) Extraoral smile view demonstrating the immediate aesthetic result.

DISCUSSION

This case combines several advanced graftless concepts in a single bimaxillary rehabilitation. In the maxilla, four zygomatic implants provide bilateral remote anchorage when the residual alveolar process is inadequate, while two pterygoid implants extend posterior support. Tomaselli's clinical reports specifically address quad-zygomatic configurations and pterygoid implants, and the basal bone anchorage concept emphasizes the importance of dense, resorption-resistant skeletal structures for immediate loading (1, 2, 11, 12).

The broader zygomatic literature reports high survival rates, but implant survival is not synonymous with treatment success. Sinusitis, oroantral communication, soft-tissue dehiscence, peri-zygomatic infection, prosthetic screw complications and unfavorable implant emergence may occur (3-8). D'Agostino and colleagues have described zygomatic implant use in oncologic defects, orthognathic-reconstructive combinations and failed maxillary reconstruction (27-29). Their 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 (9, 10).

The pterygoid implants in this case increased the anteroposterior supporting polygon beyond that achievable with zygomatic implants alone. Systematic reviews and anatomical studies support pterygoid implants as an effective option in the atrophic posterior maxilla, but the technique has a steep learning curve. The pterygomaxillary anatomy is variable, and inaccurate osteotomy orientation can compromise primary stability or endanger adjacent structures (11-16).

In the mandible, the four interforaminal implants would ordinarily support a fixed restoration with distal cantilevers. Bilateral gonial implants were added to move the terminal support posteriorly. Their placement became possible only after bilateral mobilization of the inferior alveolar nerves.

Nerve transposition provides direct access to basal bone but exposes the patient to neurosensory morbidity. Reviews consistently identify transient hypoesthesia or paresthesia as common, while persistent dysesthesia, neuropathic pain and mandibular fracture are less frequent but serious events (18-25).

From a surgical perspective, bilateral inferior alveolar nerve transposition represents one of the most distinctive aspects of this case. Mobilization of both inferior alveolar neurovascular bundles provided access to the posterior basal mandibular bone and, critically, enabled the placement of two additional implants in the gonial regions. Together with the four interforaminal implants, these posterior gonial implants created a six-implant mandibular configuration with a markedly extended anteroposterior supporting polygon (17-25).

In the mandible, bilateral inferior alveolar nerve transposition was a key graftless surgical maneuver that allowed use of the residual basal bone for posterior implant anchorage without extensive vertical bone augmentation (17-25).

However, the benefit of bilateral nerve transposition in extending posterior implant support must be balanced against its neurosensory risk, making careful patient selection, atraumatic nerve handling, and structured postoperative sensory monitoring essential (18-25).

The procedure should therefore be reserved for selected patients after comparison with alternatives such as short implants, tilted implants, vertical augmentation, or prosthetic designs confined to the interforaminal region.

The use of gonial implants also introduces biomechanical considerations. Although posterior support may decrease cantilever length, the mandible undergoes functional deformation, and a very rigid framework spanning from the symphysis to both angles may transmit stress to the interfaces. Precise framework fit, passivity, adequate restorative space, and a maintenance protocol are essential. Intraoral welding can provide immediate rigidity and reduce micromotion during early healing, but it does not compensate for inadequate primary stability, unfavorable implant positioning, or framework misfit (26).

The principal strength of the present case is the extensive photographic and radiographic documentation of a rare, combined protocol.

CONCLUSIONS

Pre-maxillary atrophy poses significant challenges in implant dentistry, affecting the aesthetics and function of oral rehabilitation.

This case report demonstrates the technical feasibility of a complex graftless bimaxillary rehabilitation using strategic remote cortical and basal bone anchorage. In the severely atrophic maxilla, the combination of four zygomatic implants and two pterygoid implants provided a broad anteroposterior distribution of support while avoiding extensive staged bone augmentation. This approach is consistent with the protocols described by Tomaselli for basal bone

anchorage, quad-zygomatic rehabilitation, and pterygoid implant placement (1, 2, 11, 12).

Aparicio et al. emphasize that evaluating zygomatic implant rehabilitation should extend beyond implant survival to include prosthetic function, sinus health, soft-tissue conditions, hygiene, and patient-related outcomes (3). Chrcanovic et al., in their systematic review, likewise reported favorable survival rates for zygomatic implants while identifying sinusitis, soft-tissue complications, oroantral communication, prosthetic complications, and implant failure as clinically relevant adverse events (4). These findings support the need for comprehensive, long-term follow-up rather than relying solely on implant survival as a measure of treatment success. The corresponding references are included in the manuscript as references 3 and 4.

Bilateral inferior alveolar nerve transposition was a pivotal component of the mandibular strategy, enabling bilateral gonial implant placement, shifting the terminal implant support posteriorly, and creating an extended six-implant supporting polygon that would not have been achievable with a conventional interforaminal approach alone (17-25).

Further studies support the use of zygomatic implants in highly compromised anatomical conditions, including severe maxillary defects, failed reconstructive procedures, and advanced maxillary atrophy (9, 10, 27-29). Their findings reinforce the importance of careful patient selection and long-term clinical, radiographic, sinus, soft-tissue, and prosthetic surveillance.

In the mandible, bilateral inferior alveolar nerve transposition enabled the placement of two posterior gonial implants in addition to four interforaminal implants. This configuration extended the supporting polygon posteriorly and reduced reliance on distal cantilevers. However, inferior alveolar nerve repositioning remains highly technique-sensitive, with temporary or permanent neurosensory disturbance as its principal potential complication (17-25). Therefore, direct visualization, atraumatic mobilization of the neurovascular bundle, protection from drilling injury, avoidance of traction or compression, and structured postoperative neurosensory monitoring are mandatory.

Bilateral inferior alveolar nerve transposition was a pivotal component of the mandibular treatment strategy because it enabled the placement of two additional implants in the gonial regions. Combined with four interforaminal implants, these posterior gonial implants created an extended six-implant supporting polygon, shifted the terminal support toward the mandibular angles, and reduced dependence on distal cantilevers (17-25).

The intraorally welded titanium bar provided immediate, rigid cross-arch stabilization and retention for the removable implant-supported full-arch prosthesis, consistent with the intraoral welding protocol described by Tomaselli (26). Nevertheless, rigid splinting cannot compensate for insufficient primary stability, inaccurate implant positioning, inadequate prosthetic planning, or framework misfit.

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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