

DECISION FACTORS IN IMMEDIATE LOADING OF DENTAL IMPLANT FOR COMPLETE EDENTULISM

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ABSTRACT

Immediate loading of dental implants has emerged as a viable option for patients with complete edentulism, offering advantages like reduced treatment time and improved patient satisfaction. However, its success depends on a multitude of interrelated clinical, anatomical, biomechanical, and prosthetic factors. This paper reviews the principal decision-making factors that influence the feasibility, planning, and predictability of outcomes for immediate loading protocols in completely edentulous patients. Evidence-based criteria and clinical guidelines are discussed to help clinicians optimize treatment strategies and minimize risks.

Key words: complete edentulism; dental implant; immediate loading; fixed oral rehabilitation; PMMA

INTRODUCTION

Complete edentulism has a significant impact on oral function, facial aesthetics, and psychological well-being [1, 2]. Conventional prostheses often fail to restore masticatory performance and, together with poor retention, lead to a shift towards implant-supported rehabilitation [3, 4].

Immediate loading (IL) of dental implants involves placing a prosthetic restoration within 48 hours of implant insertion, and it has become increasingly popular among patients and dentists [5, 6].

The popularity is due to its benefits, including reduced treatment time, immediate function, aesthetic improvements, and enhanced social life [7,8].

Immediate loading differs from conventional protocols, which typically delay implant loading for 3 to 6 months post-implant placement [9]. The rationale behind IL includes enhanced patient comfort, decreased need for removable prosthetics, and improved preservation of peri-implant structures [10, 11].

Today, the immediate function protocol of dental implants is a valid treatment alternative, and it has become a patient demand, mainly due to psychological factors and an improved quality of life [12, 13]. However, the suitability of IL depends on several decision-making factors that influence osseointegration and long-term success.

This study aims to present a standardized clinical and surgical protocol for the rehabilitation of patients with failing dentition using the All-on-Six implant technique in both the maxilla and mandible, with immediate loading of screw-retained prostheses. Additionally, the study seeks to analyze and discuss the critical clinical, anatomical, and prosthetic factors that influence decision-making in the successful implementation of immediate loading protocols for completely edentulous patients.

MATERIAL AND METHODS

Patient Selection

The patients included in this study were treated at the Helpdent Dental Clinic in Bucharest, Romania. The clinical protocol involved the rehabilitation of failing dentition using the All-on-Six implant technique with immediate loading of screw-retained provisional prostheses fabricated from polymethyl methacrylate (PMMA). All procedures were conducted in accordance with the principles outlined in the Declaration of Helsinki, and written informed consent was obtained from each patient prior to treatment.

All patients presented with a history of extensive dental caries and/or advanced periodontitis, which had led to terminal dentition. Candidates for this protocol were generally in good systemic health or had

medically managed and stable conditions at the time of surgery. Patients with systemic contraindications for oral surgery were excluded from the study.

A preliminary orthopantomogram (OPG) was performed for each patient, followed by cone-beam computed tomography (CBCT) scans to evaluate bone volume, density, and the anatomical relationship with neighboring structures. Routine blood tests were conducted to assess the medical condition for surgical intervention.

Before surgery, full-arch impressions of both the maxilla and mandible were obtained, and bite registration was performed to record the maxillomandibular relationship.

Surgical Protocol

All patients followed a standardized preoperative medication regimen consisting of Cefuroxime 500 mg and Metronidazole 500 mg, administered orally every 12 hours, beginning 24 hours before surgery and continued for a total duration of seven days to reduce the risk of postoperative infection.

Surgical procedures were performed under local anesthesia using articaine 4% with epinephrine 1:100,000, in combination with intravenous conscious sedation achieved with Midazolam. This approach ensured patient comfort and reduced anxiety while maintaining intraoperative responsiveness.

Implant placement began in the mandible, followed by the maxilla. This sequencing facilitated improved surgical access, intraoperative control, occlusal management, and prosthetic planning. A full-thickness mucoperiosteal flap was raised in both arches. Following atraumatic extraction of any remaining teeth, six titanium dental implants were placed in each arch: in the interforaminal and first

molar region of the mandible and the anterior and premolar regions of the maxilla. The implant osteotomies were prepared using standard drilling protocols following the manufacturer's guidelines. All implants were inserted into pristine bone, and no augmentation was required.

All implants achieved sufficient primary stability to permit immediate loading. Insertion torque values were ≥ 35 Ncm, and implant stability was confirmed with resonance frequency analysis, with implant stability quotient (ISQ) values ≥ 65 . These parameters met the clinical thresholds for immediate prosthetic loading [5, 14, 15]. Multi-unit abutments were then connected to the implants to accommodate the passive fit and retention of screw-retained provisional prostheses.

Prosthetic Procedure

Immediately following implant placement, a conventional open-tray impression technique was used to capture the position of the multi-unit abutments.

A screw-retained provisional full-arch prosthesis was fabricated from high-impact polymethyl methacrylate (PMMA) using computer-aided design (CAD) and computer-aided manufacturing CAD/CAM technology. The provisional prosthesis was designed with a balanced occlusal scheme and light centric contacts to reduce occlusal overload during the critical period of osseointegration. No contacts were present in lateral or protrusive excursions. A metallic bar was utilized to splint and immobilize the implants, ensuring additional stability.

The PMMA prostheses were secured to the multi-unit abutments using titanium prosthetic screws torqued at 15–20 Ncm. Final occlusal adjustments were performed intraorally to eliminate any interferences.

Postoperative care included continuation of the antibiotic regimen (Cefuroxime 500 mg and Metronidazole 500 mg, administered orally every 12 hours), analgesic medication (Nimesulide 100 mg, administered every 12 hours), and three times daily rinsing with lukewarm saline to promote soft tissue healing.

Follow-up

Patients were evaluated postoperatively at 48 hours, one week, one month, and at monthly intervals thereafter. Each follow-up included clinical assessment of soft tissue healing, prosthetic function, hygiene maintenance, and peri-implant tissue condition. Adjustments to the provisional prostheses were made as necessary to maintain function and comfort. No adverse events were reported by the patients throughout the follow-up period.

At six months, radiographic assessments were performed to evaluate crestal bone levels and confirm implant osseointegration. Patients were then scheduled for definitive prosthetic rehabilitation using a fixed screw prosthesis fabricated through CAD/CAM protocols.

RESULTS AND DISCUSSION

To demonstrate the immediate loading IL protocol, we present the clinical case of a 55-year-old male patient with a history of chronic periodontitis and long-term tobacco use (Figure 1). Despite these risk factors, the patient was in generally good systemic health and reported no current medical conditions contraindicating oral surgery. His chief complaints included poor aesthetics, diminished masticatory function, and discomfort caused by progressive tooth mobility. The patient expressed a strong preference for a fixed, long-term rehabilitative solution.

Intraoral examination confirmed generalized advanced periodontal destruction, with mobility affecting multiple teeth. A CBCT scan revealed extensive horizontal and vertical alveolar bone loss, consistent with severe periodontitis (Figure 2). Additionally, the scan showed pronounced bilateral thickening and enlargement of the Schneiderian membrane in the posterior maxilla, suggestive of chronic maxillary sinus mucosal inflammation. These anatomical findings were carefully considered during implant planning to minimize surgical risk and ensure optimal implant positioning within available bone volume.

Based on the CBCT findings, a one-stage surgical approach was selected. This involved the extraction of all remaining teeth and the immediate placement of standard dental implants in bone-rich regions that did not require augmentation. After implant insertion, multi-unit abutments were connected (Figures 3 and 4), and a definitive impression was taken to fabricate the provisional prosthesis.

The following day, screw-retained PMMA prostheses were delivered and fixed onto the multi-unit abutments (Figure 5). Occlusion was carefully adjusted to minimize loading forces during the osseointegration period. The patient reported immediate improvement in comfort and function, and no postoperative complications were observed during the early healing period (Figure 6).



Figure 1. Preoperative aspect of remaining teeth.

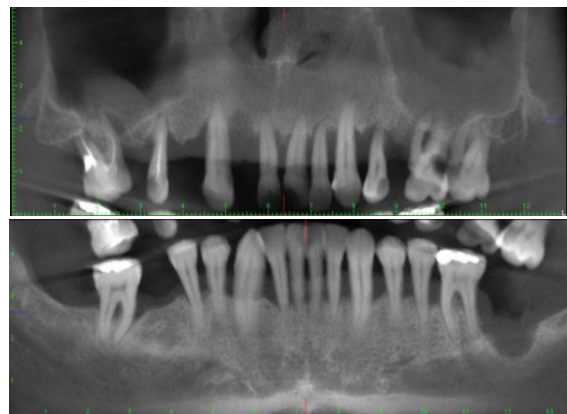


Figure 2. CBCT image showing severe periodontitis with important bone loss and enlargement of Schneiderian membrane.



Figure 3. Multiunit abutments in place.

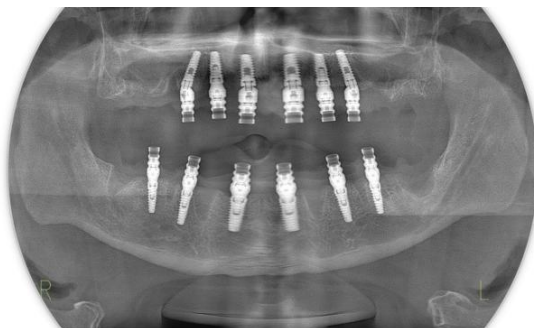


Figure 4. Postoperative OPG after surgery



Figure 5. Fixed screw PMMA dentures.



Figure 6. Periimplant tissues after wound healing.

IL differs from conventional protocols, which typically delay loading for 3 to 6 months post-implant placement. The rationale behind IL includes enhanced patient comfort, decreased need for removable prosthetics, and improved preservation of peri-implant structures. However, IL carries inherent risks if critical

clinical conditions are not satisfied. Understanding these conditions is essential for treatment success.

The primary challenge in IL is achieving sufficient implant primary stability at the time of placement, which is a key determinant of success [16, 17]. Implant primary stability, in turn, depends on a variety of factors, including bone density and quality, implant macrogeometry and surface characteristics, and surgical technique [5, 18-21]. These parameters must be carefully considered during the treatment plan, and intraoperative decision-making should be taken to ensure adequate initial fixation and minimize the risk of micromovement, which can compromise osseointegration [22].

Proper bone density and adequate bone volume are key determinants of primary implant stability. Bone quality significantly influences the primary implant stability: Type I and Type II bone—characterized by dense cortical or thick trabecular architecture—are generally considered ideal for immediate loading protocols. In contrast, Type IV bone, which consists predominantly of thin trabecular bone, presents a high risk of early implant failure in the case of IL due to insufficient initial stability.

In addition to overall bone density, the presence and thickness of the cortical bone layer are important for enhancing implant stability, due to its favorable structural and mechanical properties [23-26]. To improve primary stability in low-density bone, surgical techniques such as underpreparation of the osteotomy site appeared to be the most efficient and easiest technique. This approach increases bone compaction and promotes osseodensification, thereby enhancing the

mechanical anchorage of the implant [27-29]. A recent systematic review also supports this technique as a predictable and efficient strategy for improving outcomes in soft bone scenarios [30].

The number and distribution of implants are essential factors in the successful rehabilitation of edentulous arches with fixed dental prostheses. For full-arch restorations, a minimum of four to six implants in the mandible and six to eight implants in the maxilla is generally recommended to achieve adequate biomechanical support [31-33].

Strategic implant placement and the use of tilted implants can bypass anatomical limitations, such as the mandibular canal or maxillary sinus, thereby maximizing available bone and optimizing implant positioning [34, 35].

The concept of cross-arch stabilization is essential in this context, as it enables the even distribution of occlusal forces across the prosthesis [36, 37]. This approach reduces the risk of implant overloading, minimizes mechanical complications, and enhances the long-term success of the restoration.

A fixed screw PMMA denture was delivered 24 hours after surgery. Since occlusal load is critical in IL protocols, a balanced occlusion with minimal lateral forces was established to enhance biomechanical stability. Cantilevers were avoided where possible or minimized and occlusal contacts were avoided on them.

This biomechanical balance reduces the risk of overloading individual implants and enhances long-term stability. In cases involving IL proper occlusal adjustment is essential; premature contacts should be carefully identified and eliminated to

prevent excessive stress on the implant system.

Digital PMMA, recognized for its biocompatibility and high-density characteristics, presents an advantageous option for the fabrication of high-performance prosthetic restorations [38, 39]. Its application is indicated as an interim prosthesis during the healing and transitional stages of implant treatment.

IL outcomes are influenced not only by local anatomical and mechanical factors but also by the patient's systemic health and behavioral habits [40]. Systemic conditions such as uncontrolled diabetes, osteoporosis, and compromised immune status, and lifestyle factors such as smoking and poor oral hygiene, can interfere with healing and increase the risk of implant failure in the case of IL [41-45]. Although successful implant placement has been reported in patients with systemic conditions, immediate loading is often contraindicated in such cases due to compromised local bone quality and delayed healing capacity

[46-48].

Moreover, patient compliance with postoperative care and long-term maintenance protocols is essential for the success of IL protocols. Parafunctional habits (e.g., bruxism) and non-compliance with follow-up visits and hygiene practices are recognized contraindications to immediate loading and may significantly jeopardize implant survival [49].

The decision to employ a one-stage surgical approach combined with IL is based on clinical judgment. Clinical decision-making is guided by a comprehensive assessment of current evidence, coupled with a thorough evaluation of both local anatomical conditions and systemic patient factors. When appropriately indicated, this approach eliminates the need for a second surgical procedure, facilitates soft tissue healing, shortens overall treatment time, and enhances aesthetic outcomes—ultimately improving patient satisfaction and treatment efficiency [50, 51].

CONCLUSIONS

Immediate loading of implants in complete edentulism offers substantial benefits when applied in properly selected cases.

Decision-making must be multidimensional, incorporating anatomical, biomechanical, surgical, prosthetic, and patient-specific factors.

This approach requires careful planning, clinical experience, and effective collaboration among the surgeon, dentist, and dental technician.

Future directions include refining digital workflows and developing predictive algorithms for case selection and management.

Conflict of interest

The authors declare that they have no conflict of interests.

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