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REVIEW ARTICLE

CONTENTS

Surgical stage of dental implant placement with immediate loading: Indications and contraindications

Sviatoslav A. Ohiienko[1], Davyd S. Avetikov[2], Oksana H. Popadynets[1], Tetiana Yu. Ohiienko[1], Yaroslav V. Piuryk[1], Larysa Ya. Fedoniuk[3]

[1]IVANO-FRANKIVSK NATIONAL MEDICAL UNIVERSITY, IVANO-FRANKIVSK, UKRAINE

[2]POLTAVA STATE MEDICAL UNIVERSITY, POLTAVA, UKRAINE

[3]I. HORBACHEVSKY TERNOPIL NATIONAL MEDICAL UNIVERSITY, TERNOPIL, UKRAINE

ABSTRACT

Aim: To analyze the scientific literature on indications for and contraindications to dental implant placement using immediate loading protocols.

Materials and Methods: The scientific literature reporting clinical situations corresponding to absolute and relative indications for and contraindications to dental implant placement with immediate loading was reviewed.

Conclusions: The literature reports that one-stage implant placement with immediate loading and simultaneous placement of a transmucosal healing abutment or abutment has demonstrated effectiveness in clinical practice. However, despite its advantages, this approach has certain limitations. While absolute indications are largely determined by the potential to preserve the volume of hard and soft tissues, relative indications necessitate modifications to the existing protocol, including measures for infection control, gap management, potential biotype thickening, and modulation of the immune response. In analyzing relative contraindications, particular attention should be paid to the patient's medical history, metabolic status, the presence or absence of inflammatory processes, and the potential for their correction in collaboration with a multidisciplinary team to prevent iatrogenic injury. The implementation of modern diagnostic algorithms and biotechnologies may reduce the range of absolute contraindications; however, this approach requires careful analysis.

In experimental and clinical studies aimed at improving diagnostic algorithms and strategies for modulation of homeostasis, a personalized approach can reduce the number of relative contraindications to immediate implant placement.

KEY WORDS: dental implant placement, immediate loading, absolute and relative indications and contraindications

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INTRODUCTION

Despite the successful outcomes of osseointegration achieved with modern implant systems, long-term stability depends on numerous factors. According to the literature, several key aspects of implant placement protocols can be identified (Table 1) [1-4].

Overall, the protocol of one-stage implant placement with immediate loading is a scientifically validated standard of care that ensures esthetic excellence, soft tissue stability, and patient quality of life [5]. Careful consideration of patient selection criteria, specifically indications and contraindications, is essential, as adherence helps preserve bone and gingival tissues, stabilize the arch, and promote psychological comfort. This aspect is particularly important, since, based on clinical experience, litigation related to prosthetic procedures causing pain or facial defects often requires experts to address questions regarding the quality of care, the necessity of the interventions, and the extent of injuries inflicted by the clinician [6].

AIM

To review the scientific literature on dental implant placement with immediate loading, focusing on clinical situations in which the one-stage protocol demonstrated clear advantages over the two-stage approach and the associated risks that required modifications to the surgical technique.

MATERIALS AND METHODS

To analyze the indications for and contraindications to one-stage implant placement with immediate loading,

Table 1. Key aspects of implant placement protocols

Key aspects	Two-stage implant placement	One-stage implant placement with immediate loading
Morphofunctional	- Flattening of the soft tissue architecture. - Loss of the buccal contour and interdental papillae.	One-stage implant placement with immediate loading: - acts as a scaffold - provides mechanical support to soft tissue volume - compensates for buccal bone plate resorption - helps maintain the natural geometry and contour of the gingiva.
Histostructural	- Repeated surgical exposure of the implant and manipulations with healing abutments result in hemidesmosome disruption. - Chronic trauma to the epithelial attachment induces apical migration of the epithelium and bone resorption.	- During the first weeks after surgery, a stable mucosal barrier develops and remains intact throughout the functional period of the dental implant. - Effective protection of osseointegration from bacterial invasion is ensured.
Functional	- "Functional rest" can result in local bone atrophy due to the lack of functional loading. - Wearing removable prostheses during the healing phase exerts pressure on the periosteum and reduces vascularization.	- Control of implant micromotion and splinting allow physiological loading to be transmitted to the bone matrix, promoting osteoblastic activity and accelerating trabecular mineralization around the implant threads.
Psychosomatic	- Postoperative edentulism and the need for removable prostheses cause psychological distress.	- Avoiding a postoperative period of edentulism and wearing removable prosthesis significantly improves the patient's psychological well-being and social adaptation.

thematic sources spanning the past century were reviewed, with particular focus on the period from 2000 to 2025, drawing on substantial experience gained during the development of implantology. During this review, clinical situations were identified and categorized into groups of absolute and relative indications and contraindications.

REVIEW

Drawing on implantology experience, several clinical scenarios were identified in which avoiding immediate loading would be clinically inappropriate.

ABSOLUTE INDICATIONS

Absolute indications are cases where the one-stage protocol demonstrates clear, evidence-based advantages over the two-stage protocol.

PRESERVATION OF TISSUE VOLUME AND PREVENTION OF POST-EXTRACTION TISSUE COLLAPSE

Immediate implant placement in the extraction socket, with simultaneous placement of a prosthetic restoration (temporary crown or customized healing abutment), provides significantly higher rates of preservation of hard and soft tissue volumes than any other technique [5]. The buccal bone wall is a tooth-dependent structure largely supplied by the periodontal ligament; therefore, after tooth extraction, even atraumatic, irreversible resorption of this bone occurs, leading to changes in the gingival contour. Studies have demonstrated that soft tissues require physical support in the form of a "scaffold," whereby a temporary crown placed intraoperatively acts as a scaffold that mechanically maintains the architecture of the gingival papillae and the marginal gingival contour in their natural position (the "Dynamic Compression Technique") [7]. In delayed protocols, when primary closure of the extraction socket is achieved, or a standard cylindrical healing abutment is placed, the gingival contour flattens, and reconstruction of the lost papillae at the second stage becomes a challenging plastic surgical procedure with an unpredictable prognosis. Thus, in patients with thin and medium gingival biotypes and type I extraction sockets (intact socket walls), immediate loading is the only predictable treatment approach to achieve a favorable outcome [8].

MINIMIZING THE TRAUMA TO THE PERI-IMPLANT MUCOSAL ATTACHMENT

Within 4–6 weeks, an epithelial barrier forms around the transmucosal component. Repeated disconnection of the healing abutment or impression coping disrupts newly formed hemidesmosomes and induces apical migration of the epithelium, accompanied by marginal bone resorption of approximately 0.2–0.4 mm [9]. The immediate loading protocol implements the "One Abutment – One Time" concept, whereby the final abutment (or titanium Ti-Base) is placed under sterile conditions on the day of surgery, promoting the formation of a stable biological seal that remains undisturbed thereafter. Immediate abutment placement was associated with 0.5 mm less marginal bone loss compared to repeated abutment replacement [10].

PATIENTS WITH COMPLETE EDENTULISM OR TERMINAL PERIODONTAL TISSUE CONDITIONS

For these patients, immediate loading with full-arch restorations such as "All-on-4" or "Pro-Arch" is an absolute indication from a histological and biomechanical perspective, as the bone remodels in response to mechanical loading. Controlled immediate loading with rigid implant splinting via a full-arch framework promotes trabecular bone mineralization around the implant threads [11]. In contrast, the use of complete removable prostheses during the healing period under a two-stage protocol exerts uncontrolled pressure on the peri-implant mucosa. This compromises microcirculation, induces periosteal hypoxia, and produces implant micromotion through the soft tissues, thereby increasing the risk of implant failure. Therefore, when the total torque on the arch exceeds 120–150 Ncm, immediate prosthetic loading is indicated [12].

PRESERVATION OF ESTHETICS TO SUPPORT MENTAL HEALTH

Tooth loss often imposes a psychological burden, and the use of removable prostheses is perceived by patients as the most distressing stage of treatment, frequently resulting in reduced self-esteem and social withdrawal [12]. The Immediate Dentoalveolar Restoration (IDR) protocol helps patients avoid the functional and psychological consequences of tooth loss. Patients who achieve a positive esthetic outcome show greater adherence to oral hygiene and clinical instructions, underscoring esthetics as a key factor in supporting mental health [13].

RELATIVE INDICATIONS

Clinical scenarios in which potential risks warrant modification of the surgical strategy constitute relative indications for a one-stage protocol. In such cases, implant surgery is often performed under conditions of increased risk of early complications. The application of a one-stage protocol in these situations requires advanced surgical skills, a thorough understanding of the underlying biological processes, and the use of additional regenerative strategies [2].

INTACT, BLEEDING BONY WALLS AND THE ACHIEVEMENT OF ADEQUATE INSERTION TORQUE

Previously, periapical lesions (granuloma, cystic granuloma, or chronic periodontitis) were considered an absolute contraindication to immediate implant placement due to the risk of bacterial contamination of the implant's rough surface and the development of retrograde peri-implantitis. However, a 2010 study demonstrated that successful osseointegration in infected extraction sockets is possible, with survival rates of 92.0–96.0%, approaching those in intact sockets, provided that a meticulous debridement protocol is followed, a standardized procedure for the surgical removal of necrotic, infected tissues and contaminants from the wound [14]. If clean, bleeding bony walls are achieved after tooth extraction and curettage, and adequate insertion torque is obtained, immediate loading is considered feasible. Conversely, in the presence of an active purulent process, soft tissue swelling, or anatomical limitations that prevent complete site debridement (e.g., involvement of the maxillary sinus floor), priority is given to infection control, necessitating a delayed approach.

PROFICIENCY IN THE ONE-STAGE RECONSTRUCTION (BONE ZONE + TISSUE ZONE) FOR IMPLANT DIAMETER AND SOCKET SHAPE MISMATCH

In immediate implant placement, a mismatch between the implant diameter and the extraction socket shape creates a gap between the titanium surface and the buccal bone wall. The size and configuration of this gap are critical: a gap of less than 2 mm (jumping distance) heals spontaneously with a blood clot; however, under immediate loading, clot stability is compromised due to abutment micromotion [15]. The absence of the buccal bone wall is a high-risk scenario; therefore, immediate loading is feasible only with proficiency in the one-stage reconstruction technique (Bone Zone + Tissue Zone). This approach requires the creation of a rigid scaffold, as without it, the temporary crown would exert pressure on the soft tissues, potentially causing their recession.

INSERTION TORQUE RANGE OF 20–30 NCM

Decision-making is particularly challenging for the implantologist when primary stability falls within threshold values. Torques above 35 Ncm are considered adequate, while those below 15 Ncm are contraindicated; the 20–30 Ncm range therefore represents a gray zone. Studies have reported that implants with low insertion torque (as low as 25 Ncm) can successfully osteointegrate, as reduced compression promotes angiogenesis by preventing necrosis. However, the risk of micromotion under the load of even a non-occluding temporary crown remains critical [16]. Within this torque range, immediate loading with a crown is not recommended; therefore, placement of a customized healing abutment without occlusal contacts is advised to maintain the emergence profile. This compromise preserves the "scaffolding effect" while minimizing the risk of implant failure.

THIN GINGIVAL PHENOTYPE (<1.5 MM)

Although immediate loading is desirable to support tissue preservation, the risk of soft tissue recession during remodeling remains high, as the thin mucosa provides insufficient blood supply to the periosteum, leading to loss of the underlying bone. In such cases, immediate loading is feasible only in combination with soft tissue thickening procedures, which are more invasive and prolong the intervention [17].

ABSOLUTE CONTRAINDICATIONS

An essential component of implant procedures performed according to the immediate loading protocol is the identification of absolute contraindications. Careful consideration of these factors helps preserve the implant–bone interface and serves as a preventive measure against severe purulent-septic complications or exacerbation of systemic diseases. The literature reports that absolute contraindications arise from the inability to achieve adequate reparative osteogenesis or from decompensated systemic disturbances of homeostasis that render surgical intervention unacceptable [18].

DECOMPENSATED CARDIOVASCULAR DISEASES

This category includes acute myocardial infarction and acute cerebrovascular events (stroke) occurring within six months prior to the planned implant placement. These conditions are considered absolute contraindications, as they pose a significant risk of emergency complications during surgery. Surgical stress associated with traumatic tooth extraction and implant bed preparation leads to a substantial release of endogenous catecholamines, which, in combination with the exogenous administration of vasoconstrictors in local anesthetics, may trigger recurrent ischemic episodes, hypertensive crises, or fatal arrhythmias [19]. During the COVID-19 pandemic and the ongoing military conflict, hospitalizations for myocardial infarction and stroke have increased; therefore, careful consideration of patients' medical history is essential [20, 21]. Similar restrictions apply to patients with unstable angina, uncontrolled grade III arterial hypertension, and congestive heart failure, as in such cases the potential risk outweighs any esthetic or functional benefits of dental treatment [22].

HEMATOLOGIC AND COAGULATION DISORDERS

One-stage implant placement is a highly invasive procedure that results in an exposed surgical site, particularly around the healing abutment. Patients with inherited coagulopathies, such as hemophilia A and B or von Willebrand disease, and acquired conditions, such as thrombocytopenia with platelet counts below the critical threshold of 50×10^9/L, are at extremely high risk of massive, uncontrolled bleeding that cannot be managed with standard local hemostatic measures. Furthermore, the inability to form a stable blood clot, which serves as a biological scaffold for osteoblast migration and angiogenesis, renders osseointegration biologically impossible. Special attention should be given to patients on chronic anticoagulant therapy with vitamin K antagonists who have an international normalized ratio value exceeding 3.0. Implant surgery under these conditions, without prior dose adjustment or conversion to low-molecular-weight heparins, is considered an absolute contraindication [23].

BISPHOSPHONATE THERAPY, MAXILLOFACIAL RADIOTHERAPY, AND OBLITERATIVE ENDARTERITIS

The use of bisphosphonates, particularly when administered intravenously (e.g., zoledronic acid or pamidronate) for oncologic treatment, represents an absolute contraindication of metabolic origin. These drugs inhibit osteoclast function and induce apoptosis. Surgical intervention in such patients may result in bisphosphonate-related osteonecrosis of the jaw, characterized by bone exposure and sequestration. Numerous clinical studies report that dental implant placement during ongoing intravenous bisphosphonate therapy carries an almost 100% risk of failure and severe patient morbidity [24, 25]. A similar clinical scenario occurs in patients who received maxillofacial radiotherapy with a cumulative focal dose exceeding 50 Gray. The resulting obliterative endarteritis produces hypoxic, hypocellular, and hypovascular bone tissue, which loses its regenerative capacity and renders implant placement impossible due to the risk of osteoradionecrosis [26].

FAILURE TO ACHIEVE PRIMARY IMPLANT STABILITY

A critical threshold is an insertion torque below 35 Ncm or an implant stability quotient (ISQ) value below 60. Immediate placement of a healing abutment or temporary crown is strictly contraindicated in cases of severe alveolar ridge atrophy, low bone density (type D4), or active purulent inflammatory processes (e.g., acute periodontitis or osteomyelitis) that prevent achieving adequate implant stability. Implant micromotion exceeding the tolerated threshold of 150 μm disrupts fibrin network formation and mesenchymal cell differentiation into fibroblasts, resulting in the development of a connective tissue capsule around the titanium surface rather than osseous integration [27].

DISCUSSION

Although the mechanics of the "scaffolding effect" are understood, the optimal design of the subgingival portion of the temporary crown's emergence profile – concave or convex – remains unclear. Furthermore, the influence of temporary crown material on epithelialization of the inner surface of the gingival cuff has not been sufficiently studied. Therefore, the study of bioactive coatings for temporary abutments is particularly important, as it may convert the prosthetic restoration from a passive scaffold into an active promoter of soft tissue regeneration.

The implementation of the "One Abutment – One Time" concept is limited by the difficulty of predicting soft tissue positions. Determining the optimal abutment collar height on the day of surgery to anticipate a degree of gingival recession during healing remains a significant challenge. Errors in abutment collar height selection may result in esthetic failure (metal exposure) or biological complications (cementitis). Therefore, protocols for using scan markers on the day of surgery to fabricate individualized zirconia abutments are recommended, as this approach would integrate the accuracy of digital measurements with the biological benefits of immediate loading.

The study of how various framework materials affect stress distribution in peri-implant bone through finite element analysis (FEA), alongside clinical data on their osseointegration, represents an important area of future research.

Currently, there is no standardized protocol for chemical decontamination of infected extraction sockets before immediate loading (e.g., laser decontamination, photodynamic therapy, or antibacterial treatment). Investigating the local application of immunomodulators and antioxidants in the socket is important, as these agents may help normalize pH from acidic to neutral, a change critical for osteoblast activity at sites of prior inflammation.

The relationship between ISQ values (resonance frequency analysis) and the level of safe occlusal loading remains unclear. In particular, it is uncertain whether an implant with an insertion torque of 25 Ncm can be subjected to loading when its ISQ value exceeds 70. Therefore, developing methods to improve implant stability through osseodensification or the use of biological adhesives (e.g., fibrin sealants, gels, or biomembranes) is important to stabilize the implant in a soft extraction socket. Overall, the study of bioactive substances and biomembranes that can induce angiogenesis and promote gingival thickening without additional surgical incisions could expand the absolute indications for immediate loading.

Absolute contraindications include conditions that are potentially life-threatening or may prospectively prevent successful osseointegration (e.g., bisphosphonate-related osteonecrosis and the effects of high-dose radiation therapy).

Recent literature suggests that many relative contraindications are increasingly regarded as controllable clinical conditions owing to advances in laboratory and instrumental diagnostic algorithms. The key hypothesis is that a more comprehensive diagnostic assessment inversely correlates with the incidence of intra- and postoperative complications, thereby enabling immediate loading in patients previously considered unsuitable for this treatment approach [28].

METABOLIC DISORDERS

For a long time, diabetes mellitus was considered a significant obstacle to dental implantation, as hyperglycemia promotes the accumulation of advanced glycation end products, which negatively affect osteoblast differentiation. In addition, microcirculatory disorders develop, neutrophil chemotaxis and phagocytic activity decrease, and type I collagen synthesis by fibroblasts is suppressed. In a model of streptozotocin-induced diabetes mellitus combined with isoproterenol-induced heart failure, heterogeneous capillary congestion and stromal edema were observed [29]. However, the current diagnostic standard requires the mandatory assessment of glycated hemoglobin (HbA1c) levels, which serve as an integral indicator of carbohydrate metabolism over the preceding 3 months. Scientific evidence indicates that in patients with HbA1c levels below 7.5%, osseointegration and the long-term survival of dental implants do not differ statistically from those in systemically healthy individuals. Thus, laboratory monitoring enables precise adjustment of the treatment algorithm and surgical planning. Under conditions of stable glycemic control and adequate antibiotic prophylaxis, immediate implantation with healing abutment placement is a safe procedure [30, 31].

Edematous and degenerative changes in the cardiovascular and endocrine systems under conditions of iodine deficiency and altered thyroid status underline systemic metabolic disorders [32, 33]. Such alterations may compromise healing, increase the risk of inflammation, and impair implant osseointegration; however, restoration of normal thyroid function can lead to favorable outcomes [34].

The approach to rehabilitating patients with reduced bone mineral density (systemic osteoporosis or localized osteopenia) has undergone considerable reconsideration. Low bone density (types D3 and D4) has traditionally been regarded as a high-risk factor for immediate loading protocols due to challenges in achieving the required implant insertion torque and the associated risk of micromotion [35]. However, the implementation of cone beam computed tomography with densitometric analysis in clinical practice enables objective assessment of bone architecture during virtual treatment planning. Radiographic density measurements in Hounsfield units (HU) allow the surgeon to accurately select implant placement sites in areas of highest bone density. Intraoperative resonance frequency analysis using devices such as Osstell has been shown to provide an objective numerical measure of implant stability, expressed as the implant stability quotient (ISQ). Research demonstrates that an ISQ value above 70 allows for the safe application of immediate loading protocols, even in bone with reduced mineralization [36]. Screening serum 25-hydroxyvitamin D levels represents an important adjunct, since identification and preoperative correction of vitamin D deficiency can markedly improve the reparative capacity of bone [37].

PATIENT'S PERIODONTAL STATUS

A history of generalized periodontitis is a well-established risk factor for biological complications, such as mucositis and peri-implantitis, due to the translocation of pathogenic microbiota from periodontal pockets to the implant surface. Fungal infection is a significant factor in the pathological processes that compromise the integrity of implant-supporting bone. *Candida* species can form resilient biofilms in the oral cavity and, within polymicrobial infections, promote chronic peri-implant inflammation. Inflammation at the implant site can precede the onset of peri-implantitis or worsen its course [38]. However, the polymerase chain reaction enables precise identification and quantification of periodontopathogens of the "red complex", including *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Treponema denticola*. Antimicrobial treatment combined with comprehensive oral decontamination, aimed at achieving microbiological remission, effectively mitigates infectious risk. When a reduction in pathogen titers is confirmed, the intraoperative placement of transgingival components (healing abutments) poses no increased risk, enabling these patients to be regarded as suitable candidates for immediate implant placement [39].

CIGARETTE SMOKING

Nicotine causes sustained peripheral vasoconstriction, and carbon monoxide reduces tissue oxygenation, critically impairing the healing of peri-abutment mucosa. However, the implementation of short-term smoking cessation protocols has demonstrated high clinical effectiveness. Quitting smoking for one week before surgery and 4–6 weeks afterward restores microcirculatory function and immune response to a level sufficient for uncomplicated healing. The use of biochemical tests to measure nicotine levels allows objective monitoring of patient compliance. Thus, rather than excluding patients from treatment, the clinician can manage risk through lifestyle modification, thereby significantly expanding the indications for modern implant placement protocols [40].

CONCLUSIONS

The distinction between absolute and relative contraindications has evolved into a complex clinical decision-making system grounded in a comprehensive understanding of bone histophysiology and overall homeostasis. Scientific evidence demonstrates the potential to enhance adaptive responses to surgical trauma under loading through pharmacological interventions and lifestyle modifications. However, implementing such strategies requires clearly defined protocols for managing patients with comorbidities. Therefore, experimental and clinical studies aimed at improving diagnostic algorithms and methods for modulating an individual's dynamic equilibrium are promising.

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CONFLICT OF INTEREST

The Author declare no conflict of interest

CORRESPONDING AUTHOR

Larysa Ya. Fedoniuk
I. Horbachevsky Ternopil National Medical University
Valova street, 9, Ternopil, 46000, Ukraine
e-mail: Fedonyuk22Larisa@gmail.com

ORCID AND CONTRIBUTIONSHIP

Sviatoslav A. Ohiienko: 0000-0003-0220-8393 A D
Davyd S. Avetikov: 0000-0002-7055-3589 C D
Oksana H. Popadynets: 0000-0002-2093-5984 B E F

Tetiana Yu. Ohiienko: 0000-0002-9962-9823 B C
Yaroslav V. Piuryk: 0009-0000-3724-1009 F
Larysa Ya. Fedoniuk: 0000-0003-4910-6888 A E F

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