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Immediate load implants: systematic review of the major technical and patient comfort approaches

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Abstract

Introduction: The first implant follow-up studies constituted the scientific foundation of modern implantology. Early loading was identified as a critical factor and, therefore, several waiting times were tried until the establishment of a period of at least three months for the mandible and five to six months for the maxilla. Therefore, implant with immediate load (ILI) was defined as "installation of a prosthetic element over an implant, without OI having occurred". **Objective:** To demonstrate, through a systematic review, the clinical success rates of the immediate loading technique, present the indication criteria, and the follow-up of the procedures. **Methods:** This study followed the PRISMA model. Clinical studies were selected, involving retrospective, prospective and randomized studies. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. The bibliographic search was performed using online databases PubMed, Scopus, Web of Science, and Google Scholar. **Results and Conclusion:** A total of 135 articles were found involving immediate loading implants. A total of 78 articles were evaluated in full and 35 were included and evaluated in the present study. The analysis of the literature obtained showed that the success rates with the ILI technique are compatible with those of the late loading, as long as certain guidelines are followed, which were divided into factors related to the patient, surgical technique, implant, prosthesis, and to aesthetics. The high success rate is a consequence of correct surgical and prosthetic planning, harmony between the implant system, patient, and dentist.

Keywords: Immediate load implant. Implants. Implant dentistry. Late loading. Patient comfort.

Introduction

The use of dental implants in the rehabilitation of partially or edentulous patients followed an implant submersion protocol for 3-6 months during osseointegration (OI), to reduce the risk of implant failure caused by movements at the interface [1,2]. In this context, further improvements in surgical techniques such as implant structure and masticatory forces have led to evidence that immediate loading procedures can be successful [3]. In this sense, it is currently considered that the immediate load implant (ILI) offers many advantages for the patient and the dentist, maintaining the height of the soft tissues and increasing the peri-implant bone density [3-6]. In addition, ILI is associated with reductions in patient pain, time, and material, with success rates reported from 95 to 100% [7].

Thus, the ILI option right after surgery is indicated when the implants are placed with high insertion torques in bones of good quality, volume, and without bruxism. Also in this sense, some studies suggested that patients had generally acceptable or controlled oral hygiene, patients would be available for the postoperative period, and patients with partially reentrant arches so there would be no need to increase hard tissue in the posterior mandible [8]. In addition, smoking has been shown to have a deleterious effect on OI, but many studies have not revealed that smoking is a significant predictor of ILI. Furthermore, the results of implant surgery can be compromised by circulatory, respiratory, and hormonal factors, diseases such as diabetes mellitus, pregnancy, alcoholism,

immunodeficiency status, and vitamin D-dependent rickets [9].

In the historical and literary context, the first long-term follow-up studies of implants constituted the scientific foundation of modern implantology. Both for the two-stage surgical protocol and the single surgical stage protocol, a waiting time was required for OI to occur [10,11]. The early load was identified as a critical factor and, therefore, several waiting times were tested until the establishment of a period of at least three months for the mandible and five to six months for the maxilla [12]. This concept of a healing period, before implants were subjected to functional load, was based on previously existing knowledge related to the bone repair of fractures and osteotomies that required a period of 3 to 6 months before the functional loads could be gradually applied. In addition, the objective of that approach was also to prevent bacterial infection by exposing the implants to the oral environment, a factor that could negatively interfere with the OI process [13].

Another reason was that the premature load could lead to micro-movements that would result in the encapsulation of the implant by fibrous tissue, a fact that would prevent direct bone apposition, as well as that the necrotic bone at the edge of the implant bed would not be able to absorb the loads and should first be replaced with new bone [14,15]. With the advancement of research, even considering the high clinical success rates of techniques that advocate late loading, some researchers have begun to question the possibility of reducing the time for implants to be loaded, as loading itself would not prevent the healing process [13]. The ILI was defined as the "installation of a prosthetic element over an implant, without the OI taking place" [17].

The great disadvantage of the protocol with late load is the use of temporary prostheses lacking, in most situations, stability, and retention, generating uncomfortable situations; the need for frequent adjustments, new surgery to expose the implants, in the case of a two-stage surgical protocol, eventual psychological and social problems [18]. In contrast, the ILI concept includes advantages where discomfort, inconvenience of increased surgical time are eliminated since it is a single-stage procedure [19], decreasing the risk of overloading each implant, as it increases surface area and improves biomechanical distribution. Furthermore, the patient does not use a removable prosthesis during the initial phase of bone healing and, with this, it increases comfort, function, phonetics, stability and certainly improves psychological factors during this transition period [20].

The objective of the present study was to present, through a systematic review, the clinical success rates of the immediate loading technique, to present the indication criteria and the follow-up of the procedures.

Methods

Study Design, Quality of Studies and Bias Risk

The rules of the systematic review-PRISMA were followed (systematic reviews and meta-analyses, website: http://www.prisma-statement.org/). Clinical studies were selected, involving retrospective, prospective and randomized studies. Initially, keywords were determined by searching the DeCS tool (Descriptors in Health Sciences, BIREME base) and then verified and validated by the MeSH system (PubMed) to achieve a consistent search. The quality of the studies was based on the **GRADE instrument** and the risk of bias was analyzed according to the **Cochrane instrument**.

MeSH Terms

The main descriptors (MeSH Terms) were immediate load implant, implants, implant dentistry, late loading, patient comfort. For greater specification, the description of "immediate loading" for refinement has been added during searches. The bibliographic search was performed using online databases PubMed, Scopus, Web of Science, and Google Scholar.

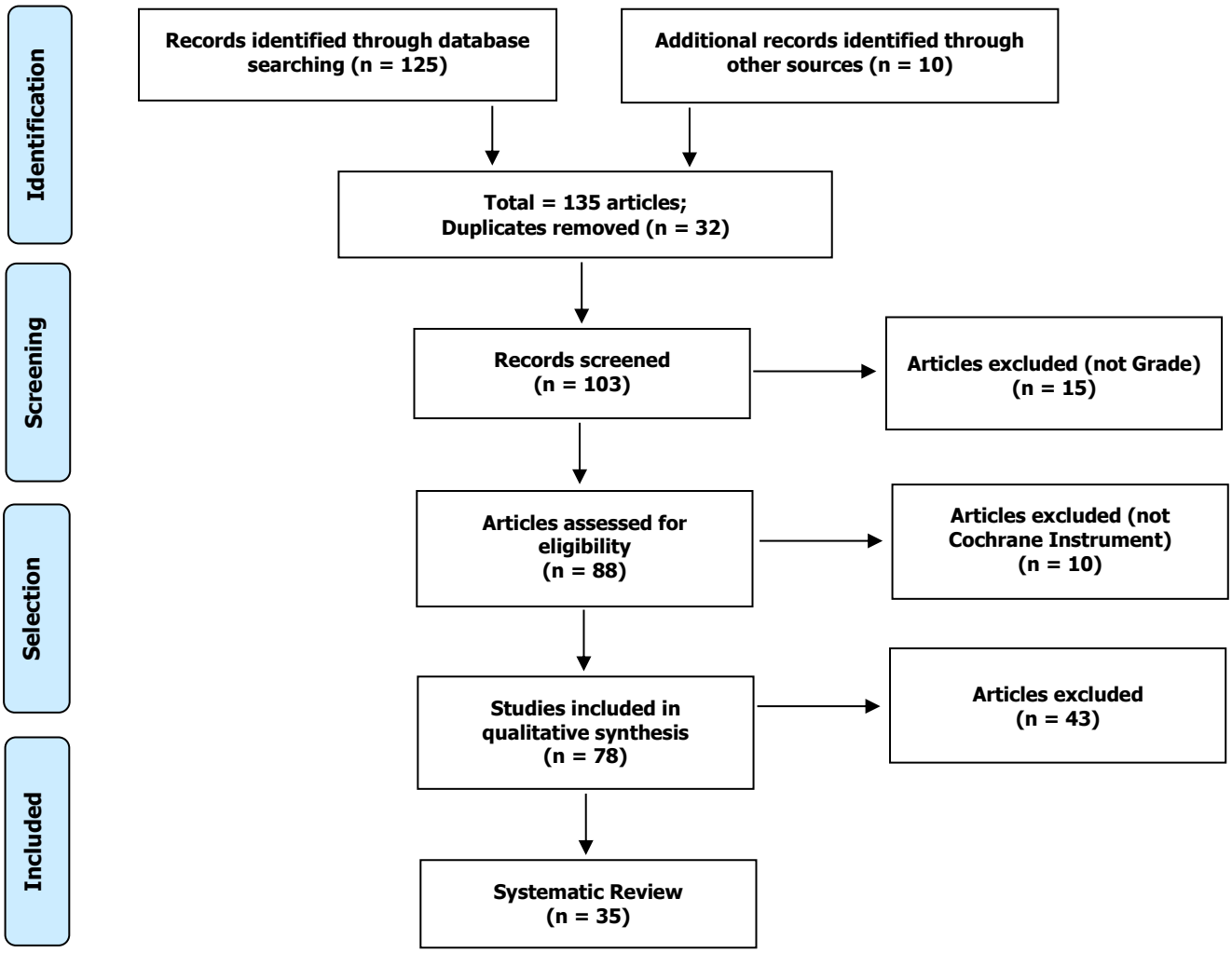
Results and Discussion

A total of 135 articles were found involving implants with immediate loading. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing articles that did not include the theme of this article. A total of 78 articles were evaluated in full and 35 were included and evaluated in the present study (**Figure 1**).

To date, there is a heterogeneity of studies on immediate load implant (ILI), and it is still difficult to generate a guideline or consensus through a meta-analysis [21,22]. In addition, it is necessary to carry out randomized clinical trials with longer follow-up [23]. Despite this, due to improvements in bioengineering techniques and implant surface topography, the ILI technique can be used successfully in many patients [24].

In this context, success rates for ILI are comparable to success rates for conventionally loaded implants. However, some trends suggest that the ILI has a shorter survival time than conventionally loaded implants. In this scenario, a high degree of insertion torque is a prerequisite for a successful procedure [25].

Figure 1. Flow chart of study eligibility.



Most of the initial works reported that the best results would be in the anterior mandible region [26-28], suggesting that the chosen region should be, strictly, between the mental foramina. But it was also demonstrated that the technique is predictable in both arches, as well as in the posterior region, and they concluded that the best results would be related to regions with better bone quality [29]. Follow-up times, with the respective success rates, were high and ranged from 18 months, with 100% to 8.6 years, with 96.7% success this factor influenced the results [30].

Another study explored the feasibility and short-term clinical outcomes of the ILI with fixed temporary bridges (2 to 4 teeth) using full digital workflow and evaluating the three-dimensional (3D) shift of the fingerprint compared to the traditional printing method. A total of 31 partially edentulous patients (16 women and 15 men) were recruited into this study. Fingerprints were taken immediately after implant placement, and temporary implant-supported splint bridges were fabricated using an all-digital approach (no template) and delivered within 24 hours. Definitive restorations were completed 4 months after surgery using the traditional impression technique. 3D printing deviations were analyzed by comparing digital and conventional printing methods. Seventy-four implants were surgically placed and immediately loaded with 34 temporary bridges fabricated using a fully digital approach. The fingerprint deviation compared to the traditional printing method was 27.43 ± 13.47 μm. The time costs for the chair and laboratory side were 32.55 ± 4.73 and 69.30 ± 10.87 minutes, respectively. Marginal bone changes were -1.58 mm and -1.69 mm at 4 and 12 months after surgery. The implants had a 100% survival rate at the 1-year follow-up time. Immediate loading of multiple implants in partially edentulous patients (2-4 teeth) with a fully digital approach is clinically applicable. The 3D discrepancy between digital and traditional printing is within the acceptable clinical range [21].

Also, a 24-month randomized controlled clinical trial investigated whether the survival of a single median implant placed in edentulous mandibles to retain a full denture is not compromised by immediate loading. Each of the 158 patients who received an implant was

randomly assigned to either the immediate loading group (n=81) or the delayed loading group (n=77). Recall visits were performed 1 month after implant placement (only for the delayed loading group) and 1, 4, 12, and 24 months after implant loading. Nine implants failed in the immediate loading group, all within the first 3 months of implant loading, and 1 implant failed in the delayed loading before loading group. Non-inferiority of implant survival in the immediate loading group compared to the delayed loading group could not be shown (p=0.81) [22]. Consistent with this result, a secondary analysis with Fisher's exact test revealed that the observed difference in implant survival between the treatment groups was indeed statistically significant (p=0.019). The most frequent prosthetic complications and maintenance interventions in the mandible were retention adjustments, prosthetic fractures, pressure ulcers, and matrix changes. There was only 1 statistically significant difference between the groups regarding the parameter "fracture of the base of the prosthesis in the area of fixation of the ball" (p=0.007). Thus, the results indicated that immediate loading of a single implant in edentulous mandibles reveals lower survival than loading delay and, therefore, should only be considered in exceptional cases [22].

Besides, as for the types of prostheses that received ILI, studies were carried out using implant-retained, mucus-supported mandibular overdentures and fixed prostheses. Some authors chose to leave part of the implants submerged so that they would heal in a conventional way (late loading), if the implants with ILI failed, with the guarantee that they would not harm the final rehabilitation works. This was also important so that they could compare the two techniques in terms of results and predictability. Overall, the first period of ILI studies had consistent scientific documentation, with long follow-up periods, showing different options for rehabilitation. In their observations, they suggested that some criteria, such as improved bone quality, use of the crossed arch, and tripod position of the implants would improve the results. They also demonstrated that the advantages of ILI include immediate function and esthetics, shortened treatment time, and greater comfort for the patient because they do not need to use the uncomfortable removable prostheses, thus improving the acceptance of the rehabilitation treatment [29-32].

Furthermore, the analysis of the literature obtained showed that the success rates with the ILI technique are compatible with those of the late load, provided that certain guidelines are followed, which were divided into factors related to the patient, the surgical technique, the implant, the prosthesis, and aesthetics. The high success rate is a consequence of correct surgical and prosthetic planning, harmony between the implant system, patient, and surgeon dentist [33]. Immediate loading is a predictable technique, as long as several clinical criteria are followed. A patient care, such as control of parafunction, bone quality, and quantity. In the surgical technique, it is important to achieve initial stability and reduce surgical trauma, as well as the professional's skill and experience. Primary and secondary stability are biomechanical characteristics directly related to the success of OI implants, both for the late loading technique and the immediate loading technique. Specific primary stability values are essential and determining factors to enable the clinical practice of the technique. Achieving primary stability is a key factor in successfully applying immediate load in the short and long term. Different areas to be rehabilitated have different biological, anatomical, and mechanical characteristics [34].

In this sense, prior preparation can reduce time and improve patient comfort. Thus, a randomized controlled trial with 20 patients analyzed immediate functional load versus non-functional load with posterior mandible restorations for marginal bone defects, implant success/survival, and patient satisfaction. A questionnaire with visual analog scales was used to assess patient satisfaction. After 36 months, data were evaluated for 9 patients (21 implants) in the study group (immediate functional load) and 10 patients (31 implants) in the control group (immediate non-functional load). One implant in the control group was lost, so the overall implant success and survival rate was 98.2%. Marginal bone defects were consistent with previous studies and comparable in both groups. Periotest values did not change significantly from baseline to 12 months of follow-up. Patient satisfaction was high and did not involve significant intergroup differences. Therefore, both types of immediate temporary restorations are feasible in selected patients [35].

As for factors related to implants, macro and micro surfaces are important. Several implant designs available help the surgeon to achieve high success rates and achieve excellent clinical results, reducing failures and losses by optimizing initial stability. In this regard, surface treatment is not a necessary condition for immediate loading success, but it can speed up the OI process, acting on secondary stability, making it desirable, as the treatment time would be shorter and the OI enhanced [35]. As for the shape, threadable, conical implants with short thread pitch, the trapezoidal shape is preferred. Length ≥ 10 mm. Diameter ≥ 3.75 mm. As for the number, in partial cases it should be 1

for each missing element; in the total maxilla, from 6 to 8 implants; in total mandibles a minimum of 3 to 4 implants. Safer connections between implant and prosthesis, in the sense that they do not come loose, are more desirable [35].

The knowledge of the aesthetic foundations in natural dentition, combined with the biology of the surrounding tissues, admits to linking them to aesthetic implantology. It is observed that much more than the technical capacity of the surgeon and the prosthetist, the preservation of the alveolar ridge and the recognition of the biological behavior of the peri-implant tissues determine the predictability of the treatment. Correct patient selection is one of the most important factors for the success of the immediate loading technique, especially in aesthetic areas, where the establishment of bone and gingival architecture, close to normal standards, is one of the most desired factors in implant dentistry [1].

As for prosthetic care, there must be a scheme to ensure that the forces are located along the tooth axis and, for this, care was suggested with the positioning of the implant, absence of cantilevers, narrow occlusal tables, and in cases of single units, there should be no occlusal contact and there is controversy regarding the need for bicorticalization. As for the region, it can be said that in total jaw rehabilitation, the ILI is a procedure with high success rates that should and can be applied in all cases where the technique is efficient to provide adequate primary stability to the implants. Therefore, the technical improvement of the dental surgeon becomes the main condition for this philosophy to be applied [2]. As for the maxilla, its approach is complex, due to the differences in the resorption pattern, compared to the mandible, the presence of anatomical repairs that may offer limitations to the placement of implants, as well as the aesthetic issue. The planning must be judiilous, obeying selection rules to be directed to a particular form of the clinical approach, which meets the aesthetic and functional needs of each case [1-3].

In single cases, it is important to take special care with the biomechanical characteristics of the implants, an occlusal scheme that avoids overload, as splinting is not possible, as well as, we must be concerned with aesthetic aspects in cases of compromised aesthetics. In addition, immediate placement minimizes the emotional trauma of losing an anterior tooth and eliminates the need for removable temporary dentures. In partial cases, care must be taken to obtain primary stability, splint, placement, and quantity of implants, care with surgery, patient and implant, and occlusion [2]. Due to its wide use over the years and many scientific works, the use of the immediate loading technique should be considered as an option in the clinic's day-to-day life, provided that reported determining factors are observed and that the surgeon has organization and mastery in the subject, but the results are not higher than those of late loading [3].

Conclusion

The analysis of the literature obtained showed that the success rates with the ILI technique are compatible with those of the late loading, as long as certain guidelines are followed, which were divided into factors related to the patient, surgical technique, implant, prosthesis, and aesthetics. The high success rate is a consequence of correct surgical and prosthetic planning, harmony between the implant system, patient, and dentist. As for the region, currently, it can be said that ILI in total rehabilitation of the mandibles is a procedure with high success rates that should and can be applied in all cases where the technique is efficient to provide adequate primary stability to the implants. Therefore, the technical improvement of the dental surgeon becomes the main condition for this philosophy to be applied.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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