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Importance of clinical evaluation for successful bone elevation for immediate implant placement: a systematic review

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Abstract

Introduction: Early implant follow-up studies laid the scientific foundation for modern implantology. Early loading was identified as a critical factor; therefore, various waiting times were explored until a period of at least three months was established for the mandible and five to six months for the maxilla. Thus, an immediate dental implant (IDI) was defined as the placement of a prosthetic element on the implant without osseointegration occurring. **Objective:** This systematic review aimed to analyze the importance of clinical evaluation and bone elevation for the success of the immediate implant technique, presenting criteria for the indication and follow-up of these procedures. **Methods:** The systematic review rules of the PRISMA Platform were followed. The search was conducted from December 2025 to January 2026 across the Web of Science, Scopus, Embase, PubMed, ScienceDirect, SciELO, and Google Scholar databases. The quality of the studies was assessed using the GRADE instrument, and the risk of bias was evaluated according to the Cochrane instrument. **Results and Conclusion:** According to the GRADE instrument, most studies presented homogeneous results, with X^2=71.7% > 50%. A total of 132 articles were found and submitted for eligibility analysis, with 22 final studies selected to compose the results of this systematic review. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 33 studies with a high risk of bias and 21 studies that did not meet GRADE and AMSTAR-2 standards. It was concluded that the high success rate is a consequence of correct surgical and prosthetic planning, and the harmony between the implant system, the patient, and the dentist. Immediate dental implant placement in total jaw rehabilitation is a procedure with high success rates that should and can be applied in all cases where the technique is efficient in providing adequate primary stability to the implants.

Keywords: Immediate dental implant. Implant dentistry. Dental implant. Maxillary sinus lift. Bone elevation.

Introduction

Immediate dental implant (IDI) with early loading has been identified as a critical factor; therefore, various waiting times have been explored until a period of at least three months for the mandible and five to six months for the maxilla was established. Thus, the safest and most effective IDI should be performed after bone augmentation with the use of biomaterials [1-3].

The first implant follow-up studies laid the scientific foundation for modern implantology. Both a two-stage surgical protocol and a single surgical procedure protocol required a waiting time for osseointegration [3,4]. This concept of a healing period, before implants are subjected to functional loading, was based on existing knowledge related to bone repair of fractures and osteotomies that required a period of 3 to 6 months before functional loads could be gradually applied [4]. With the advancement of research, even considering the high clinical success rates of delayed loading techniques, some researchers have begun to question the possibility of reducing the time for implants to be subjected to loading, since loading alone would not prevent the healing process [5,6].

As recent support from the literature, a study performed 378 implants in 56 patients. Forty upper and lower arches were restored, and 16 patients received bimaxillary rehabilitation. The average follow-up duration was 50 months, and the prevalence of implant and peri-implantitis in the patient was 14.3% and 50.0%, respectively. The mucosa affected 56.9% of the implants and 50.0% of the patients. In the same study, the survival rate was 96.4% per patient, but reached 99.5% in the implant-based analysis, and the success rate was 95.5% for implants and 80.4% for patients. Full arch restorations with full load have an acceptable outcome after 1 to 9 years of follow-up. However, the incidence of peri-implant diseases is high, and further research is needed to confirm whether they can compromise the long-term predictability of prostheses [7].

Another study showed that, based on the present systematic review, the authors report that immediate loading of zygomatic implants for severely atrophic maxillary restoration presents a viable alternative for the treatment of atrophic maxilla [2,4,8]. In addition, immediately loaded prostheses, supported by four to five implants, are a viable therapeutic option if the prostheses are made with resistant structures [5,9].

The objective of the present study was to analyze, through a systematic review, the importance of clinical evaluation and bone elevation for the success of the immediate implant technique in order to present the criteria for indication and follow-up of the procedures.

Methods

Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. Accessed at: 01/19/2026. The AMSTAR 2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: https://amstar.ca/. Accessed at: 01/19/2026.

Search Strategy and Search Sources

The literature search process was carried out from December 2025 to January 2026 and developed based on Web of Science, Embase, Scopus, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The following descriptors were used in health sciences (DeCS/MeSH terms): *"Immediate dental implant. Implant dentistry. Dental implant. Maxillary sinus lift. Bone elevation",* and the Boolean "and" was used between the MeSH terms and "or" between the historical findings.

Study Quality and Risk of Bias

Quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analyses of randomized clinical trials, followed by randomized clinical trials. Low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using Cohen's test (d).

Results and Discussion

Summary of Findings

A total of 132 articles were found and submitted to eligibility analysis, with 22 final studies selected to compose the results of this systematic review. The listed studies were of medium to high quality (Figure 1), considering the level of scientific evidence of studies such as meta-analysis, consensus, randomized clinical, prospective, and observational. Biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies presented homogeneity in their results, with X^2=71.7%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 33 studies with a high risk of bias and 21 studies that did not meet GRADE and AMSTAR-2.

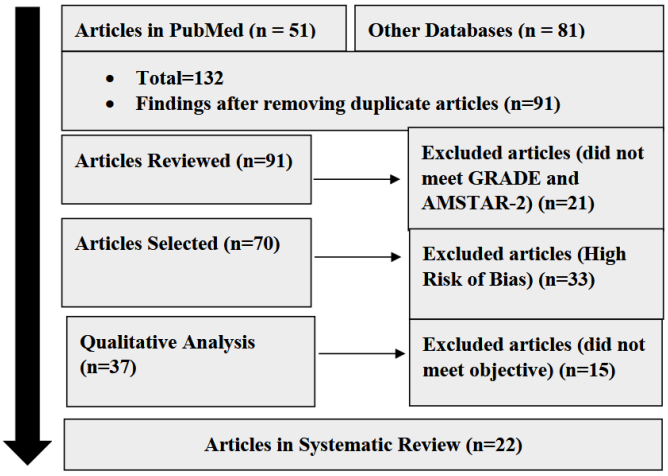

Figure 1. Flowchart showing the article selection process. Source: Own Authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). Precision (sample

size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph did not have a symmetrical behavior, suggesting a significant risk of bias, both among studies with small sample sizes (lower precision) that are shown at the base of the graph and in studies with large sample sizes that are presented at the top.

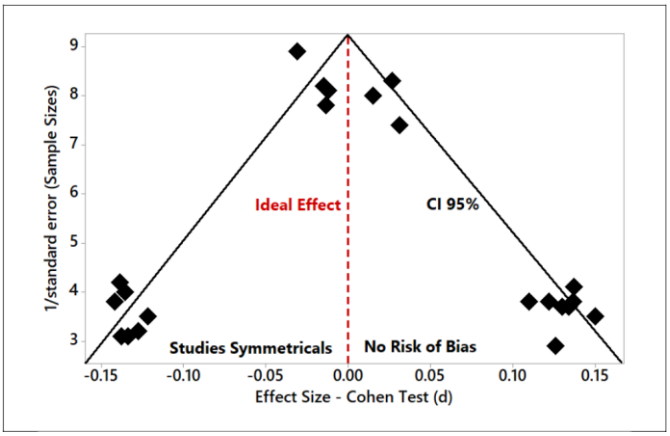

Figure 2. The non-symmetrical funnel plot suggests risk of bias among the studies with small sample sizes that are shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph (n=22 studies). Source: Own Authorship.

Major Outcomes – Bone elevation and Immediate Dental Implant

Immediate dental implant (IDI) with a fixed mandibular prosthesis showed a similar cost to the conventional loading protocol, highlighting the viability and reliability of this protocol from the patient's point of view [1-3]. In a didactic way, this review had subdivisions related to the regions and conditions under which the IDI technique can be performed: mandibles and mandibles; single, total, and partial edentulous patients, since it is known that there are particularities for each of these isolated or interrelated situations [2-5].

Chronological subdivisions were also made, with the first studies from 1986 to 1999 and the most recent up to 2017, demonstrating results and success rates of the technique. In a second part, reports were presented on the criteria necessary for the IDI technique to have favorable results, compatible with delayed loading [6].

Most initial studies reported that the best results would be in the anterior region of the mandible, suggesting that the chosen region should be "strictly between the mental foramina" [7-10]. However, it has also been shown that the technique is predictable in both arches [11], as well as in the posterior region, and it was concluded that the best results would be related to regions with better bone quality. Follow-up times, with their respective success rates, were high and ranged from 18 months, with 100.0%, to 8.6 years, with 96.7% success. This factor influenced the results [12-15].

The use of immediate loading dental implants has been performed quite frequently in implantology. The procedure for installing the loaded protocol is well documented and predictable in edentulous mandibles [13-16]. However, in the maxilla, the same type of indication is not routine, due to the possibility of failure [17]. We agree with the authors, because due to the lower bone resistance of the maxilla, obtaining adequate blockage and excellent healing in the face of immediate loading is more difficult, we consider the correct indication only for mandibular protocols [18].

Furthermore, post-extraction regions are another topic widely discussed among the dental community [1,2]. Despite being extensively studied, there is still no unanimity of opinion [3]. The determining factor in defining immediate loading is initial stability. Implants without mobility, measured by the peritoneum and with good distribution in the arch, can be subjected to immediate loading. In addition, other authors consider stability not as a numerical value, but rather the absence of mobility and clinical resistance to rotation [6,7].

Thus, based on the current literature on immediate loading implants, one study showed that a total of 378 implants were placed in 56 patients. Forty upper and lower arches were restored, and 16 patients received bimaxillary rehabilitation. The average follow-up time was 50 months, and the prevalence of implant and peri-implantitis in patients was 14.3% and 50.0%, respectively. The mucosa was affected in 56.9% of implants and 50.0% of patients [1].

The survival rate was 96.4% per patient, but reached 99.5% in the implant-based analysis, and the success rate was 95.5% for implants and 80.4% for patients. Full-arch restorations with full load had an acceptable result after 1 to 9 years of follow-up. However, the incidence of peri-implant diseases is high, and further research is needed to confirm whether they can compromise the long-term predictability of prostheses [1].

Another study evaluated the placement of 549 implants (195 immediate postextraction implants). Twelve mandibular prostheses were loaded late, while all others were loaded immediately. One year after loading, six patients fell, 12 implants failed in eight patients (two patients lost three implants each), and 87 implants were reworked in

68 patients, one for three implant failures and again in the recall program (replaced twice), one due to tree implant failure and five prosthesis fractures, 10 due to prosthesis fractures, and 74 from a prosthesis replacement program [5].

All patients were using the planned fixed prosthesis by the end of the first year of operation. Ninety-eight complications occurred in 66 patients, but all were

successfully resolved. Immediately loaded prostheses, supported by four to five implants, are a viable therapeutic option if the prostheses are made with strong frameworks [6].

Based on previous literature, a system using screw-retained implants with a Titanium Plasma Spray (TPS) surface was used in the research, and the implants were loaded within 2 to 3 days after placement using mandibular overdentures [8]. A total of 1739 implants were analyzed in 484 patients in 4 different countries: in the USA, 4 implants were placed in the anterior mandible of 129 patients, totaling 514 implants, with a 4-year follow-up and a success rate of 96.11%; in Switzerland, 446 implants were placed in 133 patients with 8 years of follow-up and a success rate of 93.04%; In Germany, 324 implants were implanted in 92 patients with a follow-up of more than 7 years and a success rate of 90.34%, and in Sweden, 455 implants were placed in 130 patients followed for 4 years with a success rate of 95.16%. 1739 implants placed, 103 implants failed over 96 months or 8 years, giving a cumulative success rate (CSR) of 87.96%. Therefore, CSR implants adhere to a good surgical and prosthetic technique, with a cost-effectiveness. The work, for the four countries, analyzed the success rates, which exceeded the guidelines and recommendations for implant success [8].

Another study using immediate implants, also using overdenture rehabilitations, presented data from 136 patients who were treated with 350 implants in edentulous mandibles in the region anterior to the mental foramen. Two systems were used: the TPS implant and the intramobile cylinder implant (ICI). The longest follow-up time was 11 years, with an average of 5.7 years. After prosthesis placement, only a few implant losses were observed. The cumulative success rate at 5.7 years was 90% for both systems (83% and 97.3% for ICI and TPS implants, respectively). A vertical bone loss of 4.0 mm was found [10].

In this context, a previously constructed prosthesis was converted into a fixed bridge supported by three implants, one in the anterior region and two in the posterior region on each side of the foramen, in seven patients [11-15]. A total of 46 implants were used; of these, 20 were placed with IDI. All implants survived for 4 months until abutment placement, but 3 failed after 3, 5, and 21 months, respectively. The follow-up time was 3.5 years. The results of this study demonstrated that implants placed in totally edentulous and partially mandibular patients can be used to support an immediate fixed prosthesis [16]. Thus, IDI is an alternative technique, in selected cases, for patients who wish to avoid the use of removable prostheses during the phases of implant rehabilitation treatment. Triploid-based prosthetic therapy did not compromise long-term implant therapy [17-19].

Another investigation was carried out to develop a method that would provide patients with a temporary fixed prosthesis placed on the day of implant placement. Sixty-three 3.85 mm diameter Nobel Biocare implants of various heights were placed in the mandibles of 10 patients and followed for 10 years. Twenty-eight implants were loaded immediately, providing support for temporary fixed prostheses, while thirty-five implants were submerged and free. After a 3-month healing period, the submerged implants were exposed, and the final reconstruction was performed. All 10 implants supported by 28 implants placed in immediate function were successful during the 3-month healing period. Of the 28 implants with TPS implantation, 4 failed. Of the 35 submerged implants, all were osseointegrated. Statistical analysis showed a 10-year IDI of 93.4% for all implants (84.7% for immediately loaded implants and 100.0% for submerged implants) [20].

A multicenter retrospective study was conducted on 226 patients rehabilitated with implanted mandibular overdentures. Four implants were introduced into the region between the mental foramina of each patient (1104 implants). Of the 226 patients treated, 194 were followed for at least 2 years and a maximum of 13 years, with an average of 6.4 years, since 32 patients stopped treatment. The implant TPS was 3.1% (24/776 of implants), and the implant failure rate was 1.5% (3/194 of bars). The results of this study showed that the TPS of immediately loaded implants was similar to that obtained with delayed loading. Unlike the delayed loading technique, which creates functional and psychological problems for patients due to the frequent instability of removable prostheses, this method shortens the rehabilitation treatment time with relevant long-term patient satisfaction [21].

Finally, the immediate loading of implants with fixed provisional restoration was evaluated in 10 patients. The selected patients were completely edentulous and had adequate bone for a minimum implant height of 10.0 mm. A minimum of 10 implants were placed in each patient. Five implants were not loaded, and the others were loaded on the day of surgery. The temporary restoration was cemented or screwed in. A total of 107 implants were placed in these 10 patients; 6 were placed in the mandible and 4 in the maxilla. Six patients were treated with Nobel Biocare implants, one with ITI implants, two with TiOblast implants (Astra), and one with a 3i implant. Sixty-seven of the sixty-nine implants that were immediately loaded osseointegrated, as did 37 of the 38 submerged implants. The results of this study indicated that

immediate loading of multiple implants, with rigid implants, around completely edentulous arches is a viable treatment modality in both arches [22].

Limitation

Major studies, encompassing diverse populations, are needed to better understand bone elevation and immediate implants. The data from the aforementioned studies in the results and discussion of this article demonstrated that, although mandibular implants could be successfully placed in immediate function to support provisional fixed prostheses, the long-term prognosis was more susceptible to implants located distally to the incisor region.

Conclusion

It was concluded that the high success rate is a consequence of correct surgical and prosthetic planning, and the harmony between the implant system, the patient, and the dentist. Immediate dental implant placement in total jaw rehabilitation is a procedure with high success rates that should and can be applied in all cases where the technique is efficient in providing adequate primary stability to the implants.

CRediT

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Informed Consent

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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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It was applied by Ithenticate®.

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

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