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Immediate dental implants and major approaches: a systematic review

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Abstract

Introduction: The use of dental implants in the rehabilitation of partially or completely edentulous patients followed a protocol of submerging the implant for 3-6 months during osseointegration to reduce the risk of implant failure caused by movements at the interface. In this context, subsequent improvements in surgical techniques such as implant structure and masticatory forces have led to evidence that immediate loading procedures can be successful (immediately loaded dental implant -ILI). **Objective:** It was to demonstrate, through a systematic review, the main clinical approaches of immediate dental implants with other types of dental implants, presenting the indication criteria and follow-up of the procedures. **Methods:** The PRISMA Platform systematic review rules were followed. The search was carried out from October 2023 to January 2024 in the Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** A total of 133 articles were found, 45 articles were evaluated in full and 37 were included and developed in the present systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 25 studies with a high risk of bias and 23 studies that did not meet GRADE and AMSTAR-2. Most studies did not show homogeneity in their results, with X^2=59.9%>50%. It was concluded that success rates with the ILI technique are compatible with those of delayed 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, and harmony between the implant system, patient, and dental surgeon. Regarding the region, it can currently be said that ILI in total jaw rehabilitation is a procedure with high success rates that should and can be applied in all cases in which the technique is efficient in providing adequate primary stability to the implants. Furthermore, the immediate provisional restoration did not have a significant peri-implant impact on the soft and hard tissues surrounding the immediately placed single dental implants.

Keywords: Immediate dental implant. Immediate loading. Early charge. Late charge. Clinical trials.

Introduction

The use of dental implants in the rehabilitation of partially or completely edentulous patients followed a protocol of submerging the implant 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, subsequent 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 considered that the immediately loaded dental implant (ILI) offers many advantages for the patient and the clinician, maintaining the height of the soft tissues and increasing the peri-implant bone density [4,5]. Furthermore, ILI is associated with reductions in patient pain, time and materials, with success rates of 95 to 100% reported [6,7].

Therefore, the option of ILI immediately after surgery is indicated when implants are placed with high insertion torques in bones of good quality, and volume and without bruxism. Still in this sense, some studies suggested that patients had generally acceptable or controlled oral hygiene, patients were available for the postoperative period and patients with partially reentrant arches so that there was no need to increase hard tissue in the posterior mandible [1,8].

Furthermore, smoking has been shown to have a deleterious effect on OI, but many studies have not revealed that smoking is a significant predictor for ILI. Furthermore, the results of implant surgery can be compromised by circulatory, respiratory, and hormonal diseases such as diabetes mellitus, pregnancy, alcoholism, immunodeficiency status, and vitamin D-dependent rickets [2,9].

The first long-term implant monitoring studies constituted the scientific foundation of modern implant dentistry. For both the two-stage surgical protocol and the single-stage surgical protocol, a waiting time was required for OI to occur [10,11]. Early loading was identified as a critical factor and therefore, various waiting times were tested until 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 the implants were subjected to functional loading was based on previously existing knowledge related to bone repair of fractures and osteotomies that required a period of 3 to 6 months before functional loading could be carried out. gradually applied. Furthermore, the objective of that approach was also to prevent bacterial infection due to the exposure of implants to the oral environment, a factor that could negatively interfere with the OI process [13].

Still, another reason given was that premature loading 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 the necrotic bone at the edge of the implant bed would not be able to absorb loads and should first be replaced by new bone [14,15].

Even considering the high clinical success rates of techniques that recommend delayed loading, some researchers began to question the possibility of reducing the time for implants to be subjected to loading, as loading in itself would not impede the healing process [16]. ILI was defined as the "installation of a prosthetic element on an implant, without OI having occurred" [3,17].

The major disadvantage of the delayed loading protocol is the use of temporary prostheses that lack, in most situations, stability and retention, generating uncomfortable situations; needs for frequent adjustments; new surgery to expose the implants, in the case of a two-stage surgical protocol; possible psychological and social problems [18]. On the other hand, the ILI concept includes advantages where discomfort and inconvenience of increased surgical time are eliminated since it is a single-stage procedure and more splinted implants can reduce the risk of overload on each implant, as it increases surface area and improves distribution. biomechanics; the patient does not use a removable prosthesis during the initial phase of bone healing and this increases comfort, function, phonetics, and stability and certainly improves psychological factors during this transition period [19,20].

Therefore, the present study aimed to demonstrate, through a systematic review, the main clinical approaches of immediate dental implants with other types of dental implants, presenting the indication criteria and follow-up of the procedures.

Methods

Study Design

The present study followed the international systematic review model, following the rules of PRISMA (preferred reporting items for systematic reviews and meta-analysis). Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. Accessed on: 01/16/2024. The methodological quality standards of AMSTAR-2 (Assessing the methodological quality of systematic reviews) were also followed. Available at: https://amstar.ca/. Accessed on: 01/16/2024.

Data Sources and Research Strategy

The literary search process was carried out from October 2023 to January 2024 and was developed based on Scopus, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various eras to the present. The descriptors (MeSH Terms) were used: *"Immediate dental implant. Immediate loading. Early charge. Late charge. Clinical trials",* and using the Boolean "and" between the MeSH terms and "or" between historical discoveries.

Study Quality and Risk of Bias

Quality was classified as high, moderate, low, or very low in terms of 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. The low quality of evidence was attributed to case reports, editorials, and brief

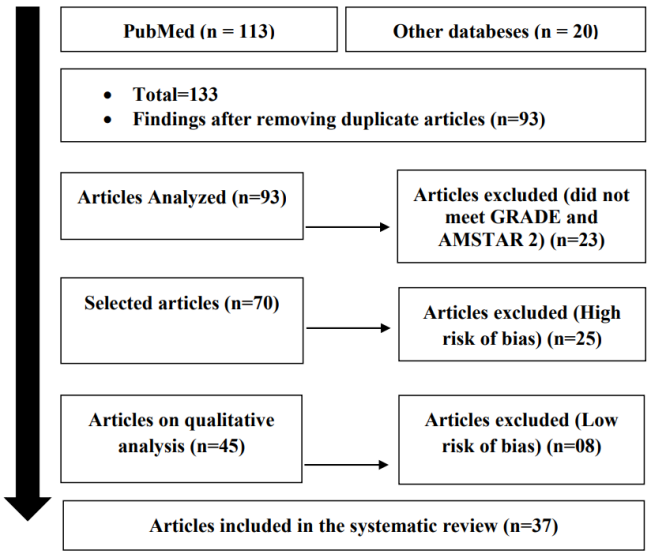
communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using the Cohen test (d).

Results and Discussion

Summary of Findings

A total of 133 articles were found that were subjected to eligibility analysis, with 37 final studies being selected to compose the results of this systematic review. The studies listed 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. The biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies showed homogeneity in their results, with X^2=59.9%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 25 studies with a high risk of bias and 23 studies that did not meet GRADE and AMSTAR-2.

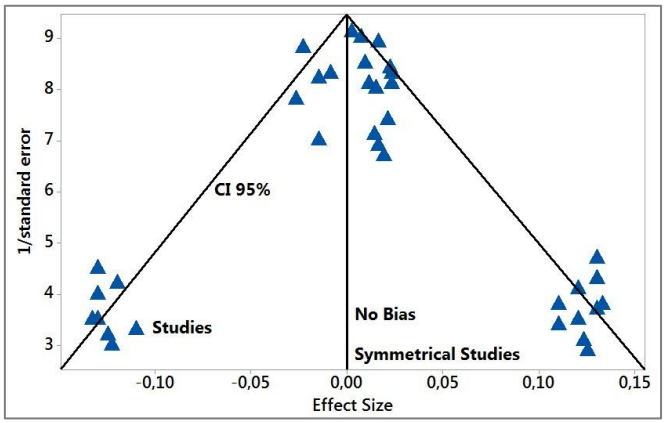
Figure 1. Article selection and exclusion process.



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 the Cohen Test (d). Precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, both between studies with a small sample size (lower precision) that are shown at the bottom of the graph and in studies with a large sample size that are presented at the top.

Figure 2. The symmetric funnel plot suggests no risk of bias among the small sample size studies that are shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph (n=37 studies).



Source: Own authorship.

Major Clinical Outcomes

Literature results revealed that immediate implant placement with an immediate provisional restoration is a well-established protocol. However, there is a lack of consensus on the impact of immediate provisional restoration on the peri-implant tissues surrounding single-unit dental implants. A recent meta-analysis study by authors Godani et al. (2024) [21] analyzed the placement of an immediate provisional restoration influences the levels of the marginal and interdental papilla (IDP) of the midfacial mucosa (MFM) around single dental implants placed in the anterior aesthetic region. The primary outcomes assessed were changes in marginal MFM and IDP levels. Additional outcomes were marginal bone loss (MB), aesthetic outcomes involving pink and white aesthetic scores (PES and WES), implant survival rates, and patient-reported outcome measures (PROMs). 16 studies were included that analyzed 836 single dental implants involving 823 patients. The meta-analysis showed no significant differences in implants with and without provisional restoration in terms of MFM marginal level, mesial IDP level, distal IDP level, and MB loss.

Another meta-analysis study by authors Patel et al. (2023) [22] compared the impact of immediate and delayed implant placement on implant survival and investigated differences in implant survival between immediate and delayed placement in adults. A total of 10 studies were eligible for inclusion, including six randomized controlled trials and four non-randomized comparative studies. Five of the six randomized trials observed a low risk of bias, while the comparative studies showed a moderate to severe risk of bias. The search strategy resulted in 341 implants placed

immediately in recent extraction sites (332 survived, 97.4%) and 359 implants placed in delayed sites (350 survived, 97.5%). Therefore, it was demonstrated that there was no significant difference in implant survival rates between implants placed immediately and implants placed using a delayed timing protocol.

In this aspect, there is a heterogeneity of studies on immediate loading implants (ILI), and it is still difficult to generate a guideline or consensus through a meta-analysis [23,24]. Furthermore, it is necessary to carry out randomized clinical studies with longer follow-up [25]. Despite this, due to improvements in bioengineering techniques and implant surface topography, the ILI technique can be used successfully in many patients [26].

In this context, the success rates for ILI are comparable to the success rates of conventionally loaded implants. However, some trends suggest that ILI has lower survival than conventionally loaded implants. In this scenario, a high degree of insertion torque is a prerequisite for a successful procedure [27].

Most of the initial studies reported that the best results would be in the anterior mandible region [28-30], suggesting that the chosen region should be, strictly, between the mental foramina [28]. However, it was also demonstrated that the technique is predictable in both arches, as well as in the posterior region, and concluded that the best results would be related to regions with better bone quality. Follow-up times, with respective success rates, were high and varied between 18 months, with 100% and 8.6 years, with 96.7% success this factor influenced the results [30-37].

In this sense, prior preparation can reduce time and improve patient comfort. Thus, a randomized controlled trial of 20 patients analyzed immediate functional loading versus nonfunctional loading with restorations in the posterior mandible 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 loading) and for 10 patients (31 implants) in the control group (immediate non-functional loading). 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 provisional restorations are feasible in selected patients [37].

Another study explored the feasibility and short-term clinical outcomes of ILI with fixed temporary bridges (2 to 4 teeth) through full digital workflow and evaluated the three-dimensional (3D) deviation of digital impression compared to the traditional impression method [28]. A total of 31 partially edentulous patients (16 females and 15 males) were recruited in this study. Fingerprints were taken immediately after implant placement, and implant-supported temporary splint bridges were fabricated using an all-digital (template-free) approach and delivered within 24 hours. The 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 complete digital approach. The deviation of digital printing compared with the traditional printing method was 27.43 ± 13.47 μm. Time costs for chairside and laboratory 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 1 year follow-up. Immediate loading of multiple implants in partially edentulous patients (2-4 teeth) with a complete digital approach is clinically applicable. The 3D discrepancy between digital and traditional impressions is within the clinically acceptable range [23].

Added to this, a 24-month randomized controlled trial investigated whether the survival of a single midline implant placed in edentulous jaws to retain a complete 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 (delayed loading group only) 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 group before loading. Non-inferiority of implant survival of the immediate loading group compared to the delayed loading group could not be shown (p=0.81) [24].

Consistent with this result, a secondary analysis with Fisher's exact test revealed that the observed difference in implant survival between treatment groups was indeed statistically significant (p=0.019). The most frequent prosthetic complications and maintenance interventions in the mandible were retention adjustments, prosthesis fractures, pressure ulcers, and matrix exchanges. There was only 1 statistically significant difference between the groups about the parameter "fracture of the prosthesis base in the ball

fixation area" (p=0.007). Thus, the results indicated that immediate loading of a single implant in edentulous jaws reveals lower survival than delayed loading and, therefore, should be considered only in exceptional cases [24].

Regarding the types of prostheses that received ILI, studies were carried out using implant-retained overdentures, mandibular mucus-supported, and fixed prostheses [31-34]. Some authors chose to leave part of the implants submerged so that they would heal conventionally (delayed loading), in case the implants with ILI failed, with the guarantee that they would not harm the final rehabilitation work. This was also important so that they could compare the two techniques in terms of results and predictability [1-3].

In general, the first period of studies on ILI 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 aesthetics, shortened treatment time, and greater comfort for the patient because they do not need to use uncomfortable removable prostheses, thus improving the acceptance of rehabilitative treatment [4,5].

The analysis of the bibliography obtained showed that the success rates with the ILI technique are compatible with those of delayed loading, as long as certain guidelines are followed, which were divided into: factors related to the patient, the surgical technique, the implant, the prosthesis and to aesthetics. The high success rate is a consequence of correct surgical and prosthetic planning, and harmony between the implant system, patient, and dental surgeon [35].

Immediate loading is a predictable technique, as long as several clinical criteria are followed. Patient care, such as control of parafunctions, 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 delayed loading technique and the immediate loading technique. Specific primary stability values are determining and essential factors to enable 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 [1,2].

Regarding factors related to implants, macro and micro surfaces are important. Various 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 successful immediate loading, but it can accelerate the OI process, acting on secondary stability, making it desirable, as the treatment time would be shorter and the OI enhanced. [3].

Regarding shape, threadable, conical implants with a short thread pitch and trapezoidal shape are preferred. Length ≥ 10 mm. Diameter ≥ 3.75 mm. As for the number, in partial cases it should be 1 for each missing element; in total jaws, from 6 to 8 implants; in total jaws a minimum of 3 to 4 implants. Connections between implants and prostheses that are safer, in the sense that they do not come loose, are more desirable [2,3].

Knowledge of the aesthetic foundations of natural dentition, combined with the biology of the surrounding tissues, allows us to relate them to aesthetic implant dentistry. It is observed that much more than the technical capacity of the surgeon and 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 [3, 4].

Regarding prosthetic care, there must be a scheme to ensure that the forces are located along the long axis of the tooth, and for this, it was suggested that care be taken with the positioning of the implant, absence of cantilevers, narrow occlusal tables and in single cases, there should be no occlusal contact. and there are controversies regarding the need for bicorticalization. Regarding the region, it can be said that in total jaw rehabilitation, ILI is a procedure with high success rates that should and can be applied in all cases in which the technique is efficient in providing adequate primary stability to the implants. Therefore, the technical improvement of the dental surgeon becomes the main condition for this philosophy to be applied [4].

As for the maxilla, its approach becomes complex, due to the differences in the resorption pattern, compared to the mandible, the presence of anatomical repairs that can offer limitations to the placement of implants, as well as aesthetic issues. Planning must be careful, following selection rules to be directed towards a specific form of clinical approach, which meets the aesthetic and functional needs of each case [5,6].

In single cases, it is important to take special care with the biomechanical characteristics of the implants,

an occlusal scheme that avoids overloading, as splinting is not possible, and we must also be concerned with aesthetic aspects in cases of compromised aesthetics. Additionally, 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, arrangement and quantity of implants, care with surgery, patient and implant, and occlusion [1].

Due to its wide use over the years and many scientific studies, the use of the immediate loading technique should be considered as an option in the day-to-day practice of the clinic, as long as the reported determining factors are observed and the surgeon has organization and mastery of the technique. subject, but the results are not superior to those of delayed loading [2,3].

Conclusion

It was concluded that success rates with the IC technique are compatible with those of delayed 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, and harmony between the implant system, patient, and dental surgeon. Regarding the region, it can currently be said that IC in total jaw rehabilitation is a procedure with high success rates that should and can be applied in all cases in which the technique is efficient in providing adequate primary stability to the implants. Furthermore, the immediate provisional restoration did not have a significant peri-implant impact on the soft and hard tissues surrounding the immediately placed single dental implants.

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Ethical Approval

Not applicable.

Informed consent

Not applicable.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

It was applied by Ithenticate[@].

Peer Review Process

It was performed.

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