

Effect Of Different Implant Placement Protocols Along With Immediate Loading On Survivability And Peri-Implant Tissue Health – A Systematic Review

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Abstract-

Aim: The purpose of this systematic review was to comparatively evaluate the survivability, crestal bone loss, and pink esthetic score of immediately loaded implants in both immediately placed and delayed placed dental implants.

Material and methods: Electronic searches of dental literature were performed to collect information on survivability, crestal bone loss, and pink esthetic score based on the objective criteria of immediate loading. The levels of evidence accepted were randomized control trials, cohort studies, retrospective clinical studies, and prospective studies.

Results – From 352 titles, 23 full-text articles were selected based on the inclusion criteria. All selected studies were broadly divided into three categories according to the antibiotic regime, site, and region. Studies pertaining to survival showed that survivability in relation to antibiotic regime (both pre- and post surgery) was – 100% in 11 studies, and 6 studies had a survival rate of more than 95%. In 4 studies, when only post surgery antibiotics were prescribed, survivability was – 96.6% - 100%. In 2 studies, when no mention of antibiotic regime was made, survivability was – 88% and 91-100%. All follow-up periods for measuring crestal bone loss were 12 months from the date of immediate loading.

Crestal bone loss has been observed in most cases ranging from 0.09 ± 0.17 mm to 2.5 mm. Immediately loaded with immediately placed implants showed more crestal bone loss than immediately loaded with delayed/conventionally placed implants.

Only seven studies mentioned the placement of 305 implants in the maxillary anterior region and evaluated soft tissue changes about the pink esthetic score. The pink esthetic score for 4 studies was more than 10 and ranged up to 15, and 3 studies had a pink esthetic score of more than 6.

Conclusion - survivability of implants immediately placed with immediate loading showed equal and/or higher survival rates when compared to delayed placed and immediately loaded implants. Crestal bone loss in both cases of immediate placement with immediate loading and delayed placement with immediate loading showed non-significant differences, and the crestal bone loss was comparable to the findings of the first European Workshop on Periodontology. The Pink Esthetic Score has been shown to be higher in cases of delayed placement with immediate loading, as it could be due to marginal preservation of soft tissue and less crestal bone loss in areas of esthetic concern.

Key Word: Immediate Loading, Immediate Implant, Delayed Implant

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I. Introduction

According to the traditional Branemark protocol, a 12-month healing period after tooth extraction is recommended before implant placement. A recovery period of 3–6 months was observed after implant fixture

placement. In most cases, this leads to 1-2 years from the start of treatment to the completion of the restoration. This often leaves patients with missing teeth or teeth for extended periods. One of the protocols that challenges the Branemark type of treatment is immediate implant placement, where a dental implant is immediately placed into an extraction socket[1]. This protocol not only decreases the duration of the entire treatment, but also reduces the number of surgeries, further decreasing the risk of hard and soft tissue resorption. According to some clinicians, immediate implant placement may limit alveolar bone loss and hence reduce the need for bone augmentation procedures.

Alveolar and peri-implant tissues displayed time-dependent alterations following tooth extraction and dental implant placement. Extractions have been found to cause alveolar ridge resorption and buccal bone loss. The magnitude of this resorption may approach 30–40%[2][3] and is attributable, in part, to rapid post-extraction resorption of the bundle bone.[4]

II. Material And Methods

Information Sources

For this systematic review, the following search engines and electronic data bases were considered by two reviewers: the National Library of Medicine's PubMed Database, Google Scholar, Scopus, and EBSCO. A search was performed to identify all peer-reviewed articles in the English literature dealing with the immediate loading of different implant placement protocols, according to the search strategy described in the following sections. The studies included for review were assessed independently by the two authors on the basis of a structured reading of articles approach, which is described in detail in the following sections.

Search strategy

A literature search was performed using the keywords "immediate loading" "immediate implant placement, " and "delayed implant placement." The search was limited to articles on adult human populations (+19 years) in the English language published over the past 10 years.

The search string was

("Immediate Loading"[Mesh] OR Implant loading [text word] OR Loading [text word] OR Immediately Loaded dental implants [text word] Immediate loaded implant [text word] OR Immediate Restoration [text word] OR Immediately Restored Implant [text word]

AND

Immediate implant placement OR immediate implant OR Immediate Dental Implantation OR Immediate dental implantation OR Immediate dental implants OR Immediate dental implant OR Immediate dental implant

AND

Delayed Implant placement OR Delayed Implant OR Delayed Dental Implantation OR Delayed dental implant OR Delayed dental implant OR Delayed dental implants OR Delayed endosseous dental implantation OR Delayed endosseous implant.

AND

Survivability OR Survival Rate OR Survival OR Success Rate OR Cumulative Survival rate

AND

Peri-Implant Tissue Health OR Peri-Implant OR Soft Tissue Health OR Hard Tissue Changes

AND

Crestal Bone Loss OR Bone Loss OR Marginal Bone Loss

AND

Pink Esthetic Score OR Esthetics

Selection process

For article selection or the first approach, two researchers independently selected potentially eligible articles by their title and abstract. Articles that met the PICO and the inclusion criteria were included in the final analysis.

Data collection process

Data werewas collected from studies that compared the effects of immediate loading with immediate implant placement and immediate loading with delayed implant placement on survivability, crestal bone loss, and pink esthetic score.

Inclusion criteria:

The inclusion criteria for admittance in the systematic review were based on the type of study, namely clinical studies on humans, assessing

- (1) The effect of immediate loading of immediately placed dental implants on survivability and peri-implant tissue health (i.e., crestal bone loss and PES).
- (2) The effect of immediate loading of conventionally placed dental implants on survivability and peri-implant tissue health (i.e., crestal bone loss and PES).

Exclusion criteria:

- (a) Studies in which outcomes were not directly related to immediate or delayed loading.
- (b) Studies that did not meet the eligibility criteria for systematic review.
- (c) Interventional studies, laboratory research, abstracts, case reports, protocols, personal opinions, letters and posters, and review of the literature.
- (e) Full text is not available.
- (d) Non-English studies

III. Result

A total of 23 prospective studies were included in this systematic review that included immediate loading of immediately placed implants and immediate loading of delayed/conventionally placed implants (implants placed in healed sockets/site).

All studies included were published from 2012 to 2022; no exception was made for including studies before 2012, apart from a review of literature and referencing on which treatment protocol was followed.

The 23 studies selected were (RCT's), prospective studies, and multicenter studies. All selected studies had a minimum follow-up period of 1 year, and eight studies selected had a follow-up of more than 1 year and a maximum of 5 years.

Survivability, crestal bone loss, and pink esthetic score were the three criteria chosen for this systematic review.

Survival Rates -

The survival rates in each study were analyzed and are summarized in Table 1. Table 1 shows the percentage of survival rates in each study with the addition of the prescribed antibiotic regimen administered to the patients. The site at which implants were placed was also mentioned, and whether the implants placed were delayed/conventional or immediate. All implants were immediately loaded with no exception.

Antibiotic regime –

All selected studies can be broadly divided into three categories, and their survivability is, as mentioned.

- a) In 17 studies, when the antibiotic regimen was prescribed both pre- and post surgery, the survivability was – 100% in 11 studies, and 6 studies had a survival rate of more than 95%.
- b) In 4 studies, when only post surgery antibiotics were prescribed, survivability was – 96.6% - 100%.
- c) In 2 studies, when no mention of antibiotic regime was made, survivability was – 88% and 91-100%.

The drug of choice for most studies was amoxicillin, and some studies included the use of clavulanic acid with amoxicillin with either BD or TID for 3-7 days. Patients allergic to amoxicillin were administered penicillin as an alternative.

Implant placement position – anterior or posterior –

Eight studies mentioned the placement of implants in the anterior maxilla, three studies mentioned the placement of implants in the anterior and posterior maxilla, and 12 studies mentioned the placement of implants both in the anterior and posterior maxilla and mandible.

A total of 427 implants were placed in the maxillary anterior region, 237 implants were placed in the anterior and posterior maxilla, and 71 implants were placed in the posterior maxilla.

A total of 657 implants were placed in the anterior and posterior regions of the maxilla and mandible and 60 implants were placed in the posterior mandible.

Implant placement site – maxilla or mandible –

Three studies mentioned the placement of implants in the mandible, 11 studies mentioned the placement of implants in the maxilla, and 8 studies mentioned the placement of implants in both the maxilla and mandible. In three studies, 141 implants were placed in the mandible, and their survival rates were 100%, 100%, and 88%, respectively. In 11 studies, 631 implants were placed in the maxilla, with an average survival rate of

more than 93%. In eight studies, 657 implants were placed in both the maxilla and mandible, with a survival rate of more than 93%. The survival rates in the maxilla were higher than those in the mandibular implants.

Crestal Bone Loss -

Crestal Bone loss in each study was analyzed and is summarized in Table 2. Table 2 shows the mean average crestal bone loss at 12 months of follow-up. Two articles did not mention crestal bone loss (M. Kern 2017, Hugo De Bruyn 2012). All follow-up periods for measuring crestal bone loss were 12 months from the date of the immediate loading.

Crestal bone loss has been seen in majority of cases ranging from 0.09 ± 0.17 mm to 2.5 mm (Guy Huynh-Ba 2019, Gianfranco Cesaretti 2015). Immediately loaded with immediately placed implants showed more crestal bone loss than immediately loaded with delayed/conventionally placed implants.

With the loading protocol for all 23 studies being immediate loading, it was shown to have a greater impact on the amount of crestal bone loss immediately loaded with immediately placed implants.

Antibiotic regime –

- a) In 17 studies when antibiotic regime was prescribed both pre and post surgery the highest and lowest crestal bone loss was – 1.6 mm (Joseph Wang, 2014) and 0.5 ± 0.5 mm (Himanshu Arora, 2017) respectively.
- b) In 4 studies when only post surgery antibiotics were prescribed, the highest and lowest crestal bone loss was – 2.5 mm (Gianfranco Cesaretti 2015) and 0.239 ± 0.158 mm (Antoine N. Berberi, 2013) respectively.
- c) In 2 studies when no mention on antibiotic regime was mentioned the crestal bone loss was – 0.24 ± 1.64 mm (Stefan Vandeweghe, 2013), one study did not mention crestal bone loss (M. Kern 2017).

Implant placement position – anterior or posterior –

Eight studies that mentioned the placement of implants only in the anterior maxilla had the highest crestal bone loss of 0.75 ± 0.69 mm (Slagter KW, 2015). 3 studies that had mentioned the placement of implants in both anterior and posterior maxilla had a highest crestal bone loss off 0.71 ± 0.68 mm (Kirsten W. Slagter, 2021). Twelve studies that had implants placed in both the anterior and posterior maxilla and mandible had the highest crestal bone loss of 1.6 mm (Joseph Wang, 2014).

Implant placement site – maxilla or mandible –

Three studies reported that the placement of implants in the mandible had the highest crestal bone loss of 0.95 ± 0.31 mm (Patrice Margossian, 2012). 13 studies that mentioned placement of implants in maxilla had highest crestal bone loss of 0.8 ± 0.4 mm (Maurizio S. Tonetti, 2017). Seven studies that mentioned placement of implants in both the maxilla and mandible reported the highest crestal bone loss of 1.6 mm (Joseph Wang, 2014)

Pink Esthetic Score (PES) –

Pink esthetic scores were analyzed and are summarized in table 3. Only seven studies mentioned the placement of 305 implants in the maxillary anterior region and evaluated soft tissue changes about the pink esthetic score. The pink esthetic score for 4 studies was more than 10 and ranged up to 15, and 3 studies had a pink esthetic score of more than 6. The lowest score was in **Guy Huynh-Ba 2019, 6.60 ± 0.44** and the highest score was in **Slagter KW 2015, 15.80 (2.05)**.

IV. Discussion

A major point of review in dental implant treatment is to decrease the total time from implant placement to final prosthesis delivery. In this attempt, a variety of treatment modalities have been tried, and after initial success, the immediate loading protocol has been widely accepted among all clinicians. However, case selection was the most significant determining factor for this treatment modality. A lot of literature has evolved over the past decade which has critically evaluated the survivability and peri-implant tissue health using factors like crestal bone loss and pink esthetic score. These parameters were evaluated for immediate loading with immediate implant placement and conventional implant placement.

The present review is based on a structured review of articles, which helped gather relevant data from each article by answering clinical questions in a PICO format. The PICO format has been used as a valuable tool for evidence-based medicine by both practitioners and researchers.

Issues related to the timing of implant placement are complicated by the lack of consensus on effective and established procedures and by the wide array of variables that have played a role in previous trials. This discrepancy in implant placement protocols and loading of implants has led to the use of different surgical protocols. With this systematic review, we will discuss which protocol has a better survival rate and provides and maintains better peri-implant tissue health.

However, several factors other than the timing of implant placement alone may affect the outcomes of procedures[7,24]. The timing of implant placement, type of bone, location and dimension of the edentulous area, and history of oral diseases are influential and should be considered in the assessment of outcomes.[25]. The method used to place the implant, such as whether flap access is used or not, the type of implant chosen, whether regenerative operations are required, the materials chosen for those procedures, and the timing of those procedures, have been found to affect the surgical outcome.[25]

Among the 23 articles included in this systematic review, as many variables as possible were addressed. Nonetheless, the following five variables were discretely analyzed:

1. Survivability of implants
2. Timing of implant placement
3. Peri-implant tissue health
4. Pink esthetic score
5. Type of implant placement protocol with loading

All the five variables were then complied and divided into 3 subcategories –

1. Antibiotic regime
2. Implant position – anterior or posterior
3. Implant position – maxilla or mandible.

These subcategories help us analyze how implant survivability, crestal bone loss, and pink esthetic scores are affected. These three subcategories were further discussed with antibiotic regime as pre- and post-surgery, post-surgery only, and when no antibiotic regime was mentioned, whether the implants were placed in the anterior or posterior region, and whether the implants were placed in the maxilla or mandible.

Survivability –

Indicating successful treatment includes a lack of biological, technical, or aesthetic complications. To estimate the success and survival rates of implant-related therapy, this systematic review evaluated 23 studies with a follow-up duration of 1–5 years or more. The literature reviewed showed a good rate of survivability in both groups, that is, immediate loading with immediate implant placement and immediate loading with conventional implant placement.

Antibiotic regime -

The question is whether antibiotics are needed for patients when a sterile environment is available during the surgical procedure. In 17 studies, when the antibiotic regimen was both pre- and post-surgery, the survival rates were 100% in 11 studies, and six studies had a survival rate of more than 95%. This leads us to believe that survivability increases with the use of pre- and post-surgery antibiotic regimens; however, according to Surapaneni, Hemchand et al. (2016), the use of a preventative antibiotic is not required before every implant surgery. However, antibiotics are helpful in preventing postoperative infections after implant placement. Antibiotic prophylaxis is necessary for dental implants to achieve high long-term survival and success rates.

The results from only the post-surgery antibiotic regime showed that the survival rates in the 4 studies were 96.6%-100% which is comparable to the survival rates of pre- and post-surgery antibiotics. The two studies that did not mention any antibiotic regimen also had survival rates of 88% and 91-100%.

The use of antibiotics has allowed the reduction of any post operative infection, which can lead to complications, but if a sterile environment is maintained, then only post operative painkillers and proper oral hygiene maintenance can lead to an increase in the survival rates of implants.

Implant position – anterior or posterior –

Placement of implants in the anterior region is of greater concern, and the seven included studies with a total of 427 implants placed in the anterior maxillary region only had a survival rate of 100% in six studies and 98% in one study with a minimum follow-up period of 1 year for all the studies.

For implants placed in the posterior region, the included studies mentioned placement in the maxillary anterior and posterior region, maxillary anterior and premolar region, maxillary and mandibular anterior and posterior region, and only 2 studies mentioned the placement of implants in the posterior mandibular region (Patrice Margossian, 2012 and Silvio Mario Meloni 2012).

A total of 237 implants were placed in the anterior and posterior maxilla, with a survival rate of 100% (Kirsten W. Slagter 2021 and Maurizio S. Tonetti 2017) and 98.3% in immediate implants, and 94.6% in conventional implants (Lyndon F. Cooper 2014)

Only (Gianfranco Cesaretti 2015) mentioned the placement of implants in the posterior maxilla, where a total of 71 implants were placed; the survivability of these 71 immediately loaded implants was 96%.

A total of 657 implants were placed in the anterior and posterior regions of the maxilla and mandible, and a total of 60 implants were placed in the posterior mandible; the survivability of these implants was more than 94%.

However, the survival rate of implants which immediately placed showed a higher percentage of survival i.e. <95-100% when compared to conventionally placed implants 90-100%.

Crestal bone loss –

Periimplant bone loss is a common observation in surviving implants. These peri-implant changes include crestal bone loss, bleeding on probing, probing depth, and pink esthetic changes and several others. This systematic review examined changes in crestal bone loss and pink esthetic scores. The first focus is on crestal bone loss, as this factor will lead to changes in probing depth and pink esthetic score.

Several studies included in the present review stated that when immediate loading or restoration was performed, peri-implant tissue health appeared to be comparable with conventional protocols, and that immediate or delayed implant placement outcomes were not compromised by immediate loading or restoration.[5,26–30]

Less crestal bone levels were observed in studies where the antibiotic regimen was administered both preoperatively and postoperatively; the bone loss was comparable to studies where the antibiotic regimen was administered only postoperatively. However, the highest level of evidence of crestal bone loss was seen at 2.5 mm (Gianfranco Cesaretti 2015) in which antibiotic regime was followed only post-op. This may be because a higher occlusal load was placed in the molar and premolar regions.[31]

When comparing crestal bone loss in anterior and posterior maxillary region the levels, they were comparable in both the regions 0.71 ± 0.68 mm (Kirsten W. Slagter, 2021) and the same was observed in anterior region only where 0.05 ± 0.06 mm (Himanshu Arora, 2018) of crestal bone loss was seen. [32,33]

Second-stage surgery is also one of the major causes of crestal bone loss, as the reflection of a flap to expose the implant at the crest leads to loss of vascularization. This trauma causes devitalization of the bone 1 mm around the implant. Subsequently, the crestal region is more susceptible to bone loss during initial repair because of its limited blood supply and the greater heat generated in this denser bone, especially with the less efficient cutting of countersink drills used in this region.

The current findings also meet the success criteria for implant treatment proposed in the consensus report of the first European Workshop on Periodontology 1993: "The criteria of success demand an average bone loss of less than 1.5 mm during the first year after insertion of the prostheses" (Albrektsson & Isidor 1994). Additionally, the present findings meet the criteria established by Albrektsson et al. (1986), who proposed that an annual marginal bone loss of less than 0.2 mm after the first year is "acceptable".

The majority of marginal bone loss was discovered in the first three months after immediate implant insertion and immediate loading, similar to soft tissue changes.[2,33–36] The average bone loss at the end of the first year was less than 1 mm.

V. Conclusion

This study provides evidence to clinicians that the widespread application of immediate implants should be reserved for highly selected cases in areas of aesthetic priority. A longer follow-up is necessary to ascertain whether greater marginal bone loss at immediate implants has implications for biological complications and long-term implant retention.

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