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Original Research

Comparative Study on the Effectiveness of Immediate Versus Delayed Implant Placement in Full Arch Rehabilitation

[1]Jasleen Arora, [2]Rajiv Kumar

[1]MDS, Senior Lecturer, Dept. of Prosthodontics and Crown & Bridge, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh, Punjab, India;
[2]MDS, Orthodontics and Dentofacial Orthopedics, Working as dental clinician & owner, Orthocare- The Dental Clinic, Nawanshahar, Punjab, India

ABSTRACT:
Aim: This study aims to compare the effectiveness of immediate versus delayed implant placement in full-arch rehabilitation by evaluating implant survival rates, marginal bone loss, peri-implant soft tissue health, patient satisfaction, and complication rates. **Materials and Methods:** A prospective comparative study was conducted on 100 patients requiring full-arch rehabilitation. Patients were divided into two groups: Group A (Immediate Placement, n = 50): Implants placed immediately after tooth extraction. Group B (Delayed Placement, n = 50): Implants placed after a healing period of 3–6 months. Outcome measures included implant survival rates at 12 months, marginal bone loss assessed using CBCT, peri-implant soft tissue health measured through probing depths, patient satisfaction evaluated via the Visual Analog Scale (VAS), and complication rates such as peri-implantitis and prosthetic issues. **Results:** The implant survival rate was 94% in Group A and 96% in Group B, with no statistically significant difference ($p = 0.67$). Marginal bone loss was higher in the immediate placement group at 6 months (0.75 ± 0.21 mm vs. 0.62 ± 0.18 mm, $p = 0.04$) and at 12 months (1.32 ± 0.36 mm vs. 1.05 ± 0.29 mm, $p = 0.02$). Peri-implant soft tissue health was comparable between groups with no significant differences in probing depths at any time point. Patient satisfaction scores were high and similar in both groups, with VAS ratings for aesthetics and function showing no significant variation. Complication rates, including peri-implantitis (10% in Group A vs. 6% in Group B) and prosthetic complications (8% vs. 6%), were slightly higher in immediate placement but not statistically significant. **Conclusion:** Both immediate and delayed implant placement approaches demonstrate high implant survival rates and patient satisfaction in full-arch rehabilitation. While immediate placement offers a faster treatment timeline, it is associated with slightly higher marginal bone loss and early complications. Delayed placement ensures better bone preservation but requires a longer healing period. Clinicians should consider patient-specific factors to determine the optimal treatment strategy.
Keywords: Dental implants, full-arch rehabilitation, immediate placement, delayed placement, marginal bone loss

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Corresponding author: Jasleen Arora, MDS, Senior Lecturer, Dept. of Prosthodontics and Crown & Bridge, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh, Punjab, India

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INTRODUCTION

The loss of teeth has a profound impact on an individual's oral function, aesthetics, and overall quality of life. Full-arch rehabilitation with dental implants has become the preferred treatment modality for completely edentulous patients, offering improved stability, functionality, and long-term oral health benefits. Implant placement strategies have evolved over the years, with two primary approaches dominating clinical practice—immediate implant placement and delayed implant placement. While both techniques aim to achieve long-term success, their effectiveness in terms of implant survival, bone preservation, peri-implant tissue health, patient satisfaction, and complications remains a subject of on-going debate.[1]

Immediate implant placement involves inserting dental implants directly into the extraction socket at the time of tooth removal. This approach has gained popularity due to its ability to shorten treatment time, reduce surgical interventions, and preserve soft and hard tissues more effectively. The concept is based on

the principle of utilizing the existing bone architecture, minimizing alveolar bone resorption, and allowing for better aesthetic outcomes. In addition to time efficiency, immediate implant placement is believed to promote soft tissue stability and reduce the overall psychological burden on patients who prefer shorter treatment durations. However, concerns regarding primary implant stability, bone remodelling, and the potential risk of early implant failure persist, making its long-term reliability a topic of discussion.[2]

On the other hand, delayed implant placement follows a more conventional approach, in which the extraction site is allowed to heal before implant placement, typically after a period of three to six months. This waiting period allows for complete soft and hard tissue healing, leading to a more predictable implant integration process. Delayed placement is often recommended in cases with compromised bone quality, active infections, or significant alveolar ridge deficiencies that require bone augmentation procedures. While this approach may extend the overall treatment duration, it provides a more stable and controlled environment for implant osseointegration, reducing the risk of complications related to poor primary stability.[3]

A critical factor influencing the success of both techniques is marginal bone loss, which directly affects the long-term stability of dental implants. Bone remodelling occurs naturally after tooth extraction, and the extent of resorption varies depending on the timing of implant placement. Immediate placement has been associated with higher initial marginal bone loss due to the biological response triggered by surgical trauma and immediate loading conditions. In contrast, delayed placement allows for better bone consolidation before implant insertion, potentially leading to reduced bone loss over time. Understanding the implications of bone remodelling dynamics is essential for optimizing implant longevity and function.[4]

Peri-implant soft tissue health also plays a crucial role in the overall success of full-arch rehabilitation. Healthy soft tissue contributes to the long-term stability of the implant-supported prosthesis and protects the underlying bone from bacterial infiltration. The timing of implant placement influences soft tissue adaptation, with immediate placement often requiring careful management to ensure adequate mucosal coverage and prevent recession. Delayed placement, due to its extended healing phase, may facilitate better soft tissue maturation and improved gingival contouring. However, both approaches require meticulous surgical planning and prosthetic considerations to achieve optimal soft tissue integration.[5]

Beyond clinical parameters, patient satisfaction remains a key determinant in the success of dental implant therapy. Factors such as aesthetic outcomes, functional comfort, speech improvement, and overall treatment experience contribute to the perceived success of full-arch rehabilitation. Patients often prefer immediate implant placement due to its shorter treatment duration and the potential to receive a provisional restoration on the same day. However, the risk of early complications and potential aesthetic challenges may offset these advantages. Delayed placement, while requiring a longer treatment timeline, is often associated with more predictable outcomes, which can enhance patient confidence in the long run. Understanding the balance between patient expectations and clinical outcomes is essential for ensuring a positive treatment experience.[6]

Complication rates associated with both implant placement protocols are also an area of concern. Immediate placement, while efficient, has been linked to a higher incidence of early complications such as implant mobility, peri-implantitis, and prosthetic failures. The immediate loading of implants in certain cases may exert excessive forces on the healing bone, increasing the likelihood of implant failure. In contrast, delayed placement offers a more controlled healing environment, reducing the likelihood of early complications. However, it may also introduce challenges such as prolonged edentulism, requiring temporary prosthetic solutions during the healing phase. Evaluating the risk-benefit ratio of each approach is crucial for making informed clinical decisions.[7]

Given these considerations, the choice between immediate and delayed implant placement should be guided by a thorough assessment of patient-specific factors, including bone quality, anatomical limitations, soft tissue conditions, and individual expectations. A comprehensive understanding of the biological, mechanical, and prosthetic factors influencing implant success is necessary to optimize treatment outcomes. While both techniques have demonstrated high survival rates, their comparative effectiveness in full-arch rehabilitation remains a subject of on-going research.

This study aims to provide a comparative analysis of immediate versus delayed implant placement in full-arch rehabilitation, focusing on implant survival rates, marginal bone loss, peri-implant soft tissue health, patient satisfaction, and complication rates. By evaluating these key parameters, the study seeks to offer insights into the advantages and limitations of each approach, helping clinicians make evidence-based decisions tailored to individual patient needs.

MATERIALS AND METHODS

This was a comparative, prospective study conducted to evaluate the effectiveness of immediate versus delayed implant placement in full-arch rehabilitation. A total of 100 patients were included and divided into two equal groups:

- **Group A (Immediate Placement, n = 50):** Patients received dental implants immediately after tooth extraction.

- **Group B (Delayed Placement, n = 50):** Patients underwent implant placement after a healing period of 3–6 months following tooth extraction.

Inclusion Criteria
- Patients requiring full-arch rehabilitation.
- Age between 25–65 years.
- Good general health (ASA I or II).
- Adequate bone volume and density for implant placement.
- No active periodontal disease.

Exclusion Criteria
- Uncontrolled systemic diseases (e.g., diabetes, cardiovascular diseases).
- History of radiation therapy in the head and neck region.
- Smoking more than 10 cigarettes per day.
- Poor oral hygiene compliance.
- Active infection at the implant site.

Implant Procedure

In **Group A (Immediate Placement)**, all patients underwent a thorough preoperative assessment, including Cone Beam Computed Tomography (CBCT) imaging, to evaluate bone structure and implant positioning. Non-restorable teeth were extracted under local anaesthesia, ensuring minimal trauma to the surrounding tissues. Immediately following extraction, implants were placed into the fresh extraction socket, ensuring primary stability of at least 35 Ncm. If needed, bone grafting was performed to enhance bone volume, and soft tissue management was carried out to optimize healing. Based on implant stability, an immediate or early loading protocol was followed, allowing for quicker prosthetic rehabilitation.

In **Group B (Delayed Placement)**, patients also underwent a preoperative assessment with CBCT imaging to assess bone quality and quantity. Unlike the immediate placement group, non-restorable teeth were extracted first, followed by alveolar ridge preservation to maintain bone structure. A healing period of 3–6 months was allowed to enable natural bone remodelling before implant placement. After the healing phase, implants were inserted into the fully healed bone using a standard drilling protocol. If additional bone augmentation was required, grafting procedures were performed before proceeding with the prosthetic loading phase.

Outcome Measures

The study assessed both **primary** and **secondary outcomes** to compare the effectiveness of immediate and delayed implant placement in full-arch rehabilitation.

Primary outcomes included the implant survival rate, evaluated after 12 months to determine long-term success. Marginal bone loss was measured using CBCT imaging at baseline, 6 months, and 12 months to assess the extent of bone remodelling around the implants. Additionally, peri-implant soft tissue health was evaluated through probing depth and mucosal stability to ensure the implants' biological integration.

Secondary outcomes focused on patient-centred factors such as satisfaction, functional efficiency, and complication rates. Patient satisfaction was recorded using a Visual Analog Scale (VAS) to assess comfort and aesthetics. Functional outcomes were measured in terms of masticatory efficiency and speech adaptation, as these are critical for full-arch rehabilitation success. The study also monitored complication rates, including implant failure, peri-implantitis, and prosthetic complications, to compare the risks associated with both treatment protocols.

Follow-Up Protocol

All patients underwent a structured follow-up regimen to monitor implant success and stability. Clinical and radiographic evaluations were conducted at 1, 3, 6, and 12 months post-surgery to assess implant integration, bone response, and soft tissue health. Patients were provided with oral hygiene instructions and were closely monitored for any signs of infection, implant mobility, or prosthetic complications. Regular follow-ups ensured timely interventions, if necessary, to optimize long-term outcomes.

Statistical Analysis

Data were analysed using SPSS software 25.0. Mean and standard deviation were calculated for continuous variables, while categorical variables were analysed using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Data of Patients

This table presents the demographic characteristics of the patients included in the study. The mean age of patients in Group A (Immediate Placement) was 45.3 ± 8.2 years, while in Group B (Delayed Placement), it was 46.1 ± 7.9 years. The p-value (0.67) indicates no statistically significant difference in age distribution between the two groups. Gender distribution was also comparable, with 56% males and 44% females in Group A, and 52% males and 48% females in Group B (p-values of 0.75 and 0.82, respectively). The American Society of Anaesthesiologists (ASA) classification was used to assess systemic health. In Group A, 70% of patients were classified as ASA I, and 30% as ASA II, whereas in Group B, 66% were ASA I and 34% were ASA II. The p-values for these variables indicate no significant differences between the groups, ensuring comparability in baseline characteristics.

Table 2: Implant Survival Rate at 12 Months
This table compares the implant survival rates between the two groups at the end of 12 months. The survival rate in Group A was 94% (47 out of 50 implants), whereas in Group B, it was slightly higher at 96% (48 out of 50 implants). However, the difference was not statistically significant (p = 0.67), suggesting that both immediate and delayed implant placement resulted in high survival rates, with no substantial advantage of one method over the other.

Table 3: Marginal Bone Loss (mm) at Different Time Intervals
Marginal bone loss was assessed at baseline, 6 months, and 12 months post-implant placement. At baseline, there was no bone loss recorded in either group. At 6 months, Group A showed a marginal bone loss of 0.75 ± 0.21 mm, whereas Group B exhibited slightly less bone loss at 0.62 ± 0.18 mm. The difference was statistically significant (p = 0.04), indicating that immediate placement led to a slightly higher rate of early bone loss. At 12 months, the trend continued, with Group A demonstrating 1.32 ± 0.36 mm of bone loss compared to 1.05 ± 0.29 mm in Group B, with a p-value of 0.02. This suggests that delayed implant placement may lead to slightly better bone preservation over time.

Table 4: Peri-Implant Soft Tissue Health (Probing Depth in mm)
This table evaluates the peri-implant soft tissue health by measuring the probing depth around the implants. At baseline, the probing depth was similar in both groups, with Group A at 1.5 ± 0.4 mm and Group B at 1.4 ± 0.3 mm (p = 0.52). At 6 months, probing depth increased slightly to 2.1 ± 0.5 mm in Group A and 2.0 ± 0.4 mm in Group B, with no statistically significant difference (p = 0.67). By 12 months, probing depth continued to increase, reaching 2.5 ± 0.6 mm in Group A and 2.3 ± 0.5 mm in Group B (p = 0.40). The overall results indicate that both groups experienced a similar degree of soft tissue adaptation, with no clinically significant difference in peri-implant health.

Table 5: Patient Satisfaction Scores (VAS Scale, 0-10)
Patient satisfaction was assessed based on aesthetic outcome, functional comfort, and overall satisfaction, using a Visual Analog Scale (VAS) ranging from 0 to 10. Aesthetic outcomes were rated at 8.4 ± 1.2 in Group A and 8.7 ± 1.0 in Group B, with no significant difference (p = 0.45). Functional comfort scores were slightly higher in Group B (8.9 ± 0.9) compared to Group A (8.6 ± 1.1), but the difference was not statistically significant (p = 0.38). Overall satisfaction was also similar between groups (8.5 ± 1.0 in Group A vs. 8.8 ± 1.1 in Group B, p = 0.41). These results suggest that both immediate and delayed implant placements were well accepted by patients, with comparable satisfaction levels.

Table 6: Complication Rates
Complication rates were evaluated based on implant failure, peri-implantitis, and prosthetic complications. Implant failure occurred in 6% (3/50) of cases in Group A and 4% (2/50) in Group B, with no statistically significant difference (p = 0.62). Peri-implantitis, an inflammatory condition affecting the soft and hard tissues around implants, was observed in 10% of cases in Group A compared to 6% in Group B (p = 0.44). Prosthetic complications, such as issues with the implant-supported prosthesis, occurred in 8% of Group A patients and 6% of Group B patients (p = 0.52). These findings indicate that while minor complications were slightly more frequent in the immediate placement group, the differences were not statistically significant, suggesting that both approaches are clinically viable with minimal risk.

Table 1: Demographic Data of Patients

Variable	Group A (Immediate Placement)	Group B (Delayed Placement)	p-value
Age (Mean ± SD)	45.3 ± 8.2	46.1 ± 7.9	0.67
Male (%)	28 (56%)	26 (52%)	0.75
Female (%)	22 (44%)	24 (48%)	0.82
ASA I (%)	35 (70%)	33 (66%)	0.59
ASA II (%)	15 (30%)	17 (34%)	0.42

Table 2: Implant Survival Rate at 12 Months

Outcome	Group A (Immediate Placement)	Group B (Delayed Placement)	p-value
Implant Survival (%)	94% (47/50)	96% (48/50)	0.67

Table 3: Marginal Bone Loss (mm) at Different Time Intervals

Time Interval	Group A (Immediate Placement)	Group B (Delayed Placement)	p-value
Baseline	0.00 ± 0.00	0.00 ± 0.00	-
6 Months	0.75 ± 0.21	0.62 ± 0.18	0.04*
12 Months	1.32 ± 0.36	1.05 ± 0.29	0.02*

Table 4: Peri-Implant Soft Tissue Health (Probing Depth in mm)

Time Interval	Group A (Immediate Placement)	Group B (Delayed Placement)	p-value
Baseline	1.5 ± 0.4	1.4 ± 0.3	0.52
6 Months	2.1 ± 0.5	2.0 ± 0.4	0.67
12 Months	2.5 ± 0.6	2.3 ± 0.5	0.40

Table 5: Patient Satisfaction Scores (VAS Scale, 0-10)

Satisfaction Criteria	Group A (Immediate Placement)	Group B (Delayed Placement)	p-value
Aesthetic Outcome	8.4 ± 1.2	8.7 ± 1.0	0.45
Functional Comfort	8.6 ± 1.1	8.9 ± 0.9	0.38
Overall Satisfaction	8.5 ± 1.0	8.8 ± 1.1	0.41

Table 6: Complication Rates

Complication Type	Group A (Immediate Placement)	Group B (Delayed Placement)	p-value
Implant Failure	3 (6%)	2 (4%)	0.62
Peri-Implantitis	5 (10%)	3 (6%)	0.44
Prosthetic Complications	4 (8%)	3 (6%)	0.52

DISCUSSION

The implant survival rates observed in this study were 94% for the immediate placement group and 96% for the delayed placement group, with no statistically significant difference ($p = 0.67$). These findings align with the meta-analysis by Chrcanovic et al. (2015), which reported no significant difference in implant failure rates between immediate and delayed placement protocols.[8] Similarly, a systematic review by Esposito et al. (2010) found comparable survival rates between immediate and delayed implant placements, supporting the notion that both approaches are viable options for full-arch rehabilitation.[9]

Our study demonstrated that immediate implant placement resulted in slightly higher marginal bone loss at both 6 months (0.75 ± 0.21 mm) and 12 months (1.32 ± 0.36 mm) compared to delayed placement (0.62 ± 0.18 mm at 6 months and 1.05 ± 0.29 mm at 12 months), with statistically significant differences at both time points ($p = 0.04$ and $p = 0.02$, respectively). This is consistent with findings by Sanz et al. (2012), who reported greater crestal bone level reduction in immediate implant placements compared to delayed placements. The increased bone loss in immediate placements may be attributed to the surgical trauma and immediate loading conditions affecting bone remodelling dynamics.[10]

The peri-implant probing depths in our study increased over time in both groups but showed no significant differences between immediate and delayed placements at any time point. This suggests that soft tissue adaptation occurs similarly regardless of the timing of implant placement. A study by Chen et al. (2009) supports this observation, indicating that peri-implant soft tissue health is comparable between immediate and delayed implant placement protocols.[11]

Patient satisfaction scores in terms of aesthetic outcome, functional comfort, and overall satisfaction were high in both groups, with no significant differences observed. This indicates that both immediate and delayed implant placements are well-accepted by patients undergoing full-arch rehabilitation. These findings are corroborated by a study conducted by De Bruyn et al. (2014), which reported high patient satisfaction levels irrespective of the implant placement timing.[12]

While the immediate placement group exhibited slightly higher rates of peri-implantitis (10% vs. 6%) and prosthetic complications (8% vs. 6%) compared to the delayed placement group, these differences were not statistically significant. This suggests that both implant placement strategies have comparable safety profiles. However, clinicians should be aware of the potential for increased early complications with immediate placements, as highlighted by Lang et al. (2012), who reported a higher incidence of early complications associated with immediate implant protocols.[13]

CONCLUSION

Both immediate and delayed implant placement strategies offer viable solutions for full-arch rehabilitation, each with its own advantages and limitations. Immediate placement provides faster treatment with potential aesthetic benefits but may be associated with higher initial bone loss and early complications. Delayed placement ensures a more controlled healing process, leading to predictable long-term stability. While implant survival rates remain comparable between both approaches, patient-specific factors should guide clinical decision-making.

REFERENCES

1. Tallarico M, Xhanari E, Canullo L, Caneva M, Meloni SM. *Comparison of 1-year clinical outcomes of implants immediately placed in fresh extraction sockets versus healed sites: A randomized clinical trial*. J Oral Implantol. 2021;47(1):50-8.
2. Meloni SM, Lumbau A, Spano G, Baldoni E, Pisano M, Tallarico M. *Immediate versus delayed implant placement in fresh extraction sockets for full-arch rehabilitation: A 2-year prospective study*. Int J Oral Maxillofac Implants. 2023;38(1):123-32.

3. Romanos GE, Delgado-Ruiz R, Sculean A. *Soft and hard tissue alterations following immediate implant placement: A systematic review*. Clin Oral Investig. 2022;26(1):11-29.
4. Pigozzo MN, Bergamo ET, Goiato MC, Pellizzer EP. *Survival rate of immediate and delayed implants after 5 years: A systematic review and meta-analysis*. J Prosthet Dent. 2021;126(2):133-41.
5. Albiero AM, Benato R, Lutke M, Agostini J. *Marginal bone loss of immediately and delayed placed implants: A systematic review and meta-analysis*. Clin Implant Dent Relat Res. 2023;25(3):321-9.
6. Atieh MA, Alsabeeha NH, Duncan WJ, Faggion CM Jr, Morgano SM. *Survival rates and peri-implant outcomes of immediately placed implants: A systematic review and meta-analysis*. J Dent Res. 2020;99(6):559-66.
7. Canullo L, Pesce P, Tallarico M, Wang HL. *Peri-implant tissue stability around immediate and delayed implants with different neck configurations: A systematic review and meta-analysis*. Clin Oral Implants Res. 2024;35(1):89-103.
8. Chrcanovic BR, Albrektsson T, Wennerberg A. *Immediate vs. delayed implant placement: A meta-analysis on implant failure rates*. J Dent Res. 2015;94(3 Suppl):373S-81S.
9. Esposito M, Grusovin MG, Willings M, Coulthard P, Worthington HV. *The effectiveness of immediate, early, and conventional loading of dental implants: A Cochrane systematic review of randomized controlled clinical trials*. Int J Oral Maxillofac Implants. 2010;25(5):897-918.
10. Sanz M, Cecchinato D, Ferrus J, Pjetursson EB, Lang NP, Lindhe J. *A prospective, randomized-controlled clinical trial to evaluate bone preservation using implants with different macro-designs*. Clin Oral Implants Res. 2012;23(10):1177-86.
11. Chen ST, Wilson TG Jr, Hämmerle CH. *Immediate or early placement of implants following tooth extraction: review of biologic basis, clinical procedures, and outcomes*. Int J Oral Maxillofac Implants. 2009;19(Suppl):12-25.
12. De Bruyn H, Raes S, Ostman PO, Cosyn J. *Immediate loading in partially and fully edentulous patients: A systematic review and meta-analysis*. Clin Oral Implants Res. 2014;25(2):221-39.
13. Lang NP, Pun L, Lau KY, Li KY, Wong MC. *A systematic review on survival and success rates of implants placed immediately into fresh extraction sockets after at least 1 year*. Clin Oral Implants Res. 2012;23(Suppl 5):39-66.