

Research Article

Evaluating the Success Rate of Immediate Vs Delayed Implant Placement in Maxillary Anterior Teeth

Dr. Muhammad Junaid Hashmi^{1*}, Dr. Labiba Hassan², Dr Ashfaq Ahmed³, Dr. Zahid Akhtar ⁴

^{1*}Assistant Professor, Department of Community and Preventive Dentistry, Shahida Islam Dental College, Lodhran.

²Assistant Professor of Oral and Maxillofacial Surgery, Shahida Islam medical and dental college Lodhran.

³Senior Registrar, Department of Oral and Maxillofacial Surgery Shahida Islam Medical and Dental College Lodhran.

⁴Assistant Professor, Department of prosthodontics, Shahida Islam Dental College, Lodhran.

Email: ^{1*}Drjunaidhashmi57@gmail.com, ²labiba_hassan@hotmail.com, ³drashfaqpirkani@gmail.com, ⁴zak231980@gmail.com

Corresponding Author: Dr. Muhammad Junaid Hashmi

Assistant Professor, Department of Community and Preventive Dentistry, Shahida Islam Dental College, Lodhran.

Email: Drjunaidhashmi57@gmail.com

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ABSTRACT

Background: Replacement of missing maxillary anterior teeth presents significant functional and esthetic challenges in implant dentistry.

Objective: To compare the success rate, clinical outcomes, radiographic findings, esthetic results, and patient satisfaction between immediate and delayed implant placement in maxillary anterior teeth.

Study Design: Comparative observational study.

Place and Duration of Study: Conducted at Department of Community and Preventive Dentistry, Shahida Islam Dental College, Lodhran from November 2024 to August 2025.

Methodology: A total of 85 patients requiring single-tooth implant replacement in the maxillary anterior region were enrolled in the study. Patients were divided into two groups according to the timing of implant placement: Immediate Implant Placement Group (n=42) and Delayed Implant Placement Group (n=43).

Results: The mean age of the study population was 38.72 ± 10.54 years. Implant success rates were 95.2% in the immediate placement group and 93.0% in the delayed placement group, with no significant difference between groups ($p=0.671$). Implant Stability Quotient values were comparable (74.5 ± 4.2 vs. 72.9 ± 4.6 ; $p=0.094$). Marginal bone loss was significantly lower in the immediate placement group (0.68 ± 0.29 mm) than in the delayed placement group (0.82 ± 0.34 mm; $p=0.043$).

Conclusion: Both immediate and delayed implant placement achieved high success rates in maxillary anterior teeth.

Keywords: Dental Implants, Immediate Implant Placement, Delayed Implant Placement, Maxillary Anterior Teeth.

INTRODUCTION

The high success rate, excellent esthetic result, and conservation of neighboring tooth structure make dental implant therapy the treatment of choice for tooth replacement. Replacement of maxillary anterior teeth poses a special clinical challenge because this area is extremely exposed during speech and smiling, and both functional and esthetic results are crucial. Some variables that are key for success in this esthetic area are: achieving optimal implant stability, soft tissue architecture, preservation of alveolar bone dimensions [1,2]. After tooth extraction, the alveolar ridge undergoes extensive remodeling, especially in the initial three to six

months. This can lead to horizontal and vertical bone loss, possibly affecting implant placement and esthetic results. In response to these issues, other implant placement strategies have been developed, such as immediate implant placement during tooth extraction, and delayed implant placement after full socket healing [3,4]. There are potential benefits to immediate implant placement such as fewer surgical procedures, patient satisfaction, preservation of alveolar bone and shorter treatment time. The technique includes placing the implant into a newly formed extraction site, thereby achieving early rehabilitation, and possibly reducing any

post-extraction tissue collapse. Immediate implant placement has been further enhanced in certain selected cases by the development of new implant surface technology, surgical techniques and by a new concept, called guided bone regeneration [5,6]. However, there are also some drawbacks and risks to immediate implants. The risk of complications like implant failure, gingival recession, and esthetic issues may be higher if any of these factors are present: infection, weak primary stability, thin buccal bone plates, soft tissue deficiencies. Thus, case selection and careful surgical planning is vital for a successful outcome [7,8]. Delayed implant placement continues to be a widely accepted treatment approach, especially when there is a great deal of bone loss, infection, or soft tissue issues to deal with. Delayed protocols may result in a more favorable biological environment for osseointegration and allow for further ridge augmentation if needed, due to the time that is allowed for complete healing of the extraction sockets before the implants are placed. The delay in placement, however, prolongs the treatment and may result in several surgical procedures, affecting patient comfort and satisfaction [9,10]. There have been several clinical trials and systematic reviews that have compared the two implant placement protocols in terms of implant survival, marginal bone loss, stability of the peri-implant soft tissues, esthetic outcomes and satisfaction of the patient. Many studies have yielded similar results, and some have demonstrated a slightly higher rate at which the two methods have been equally successful, while others have shown differences in long-term success and esthetic predictability [11,12] due to variations in study design, follow-up period, patient selection, and surgical technique.

Objective

To compare the success rate, clinical outcomes, radiographic findings, esthetic results, and patient satisfaction between immediate and delayed implant placement in maxillary anterior teeth.

METHODOLOGY

This was a comparative observational study conducted at Department of Community and Preventive Dentistry, Shahida Islam Dental College, Lodhran from November 2024 to August 2025. A total of 85 patients requiring implant placement in the maxillary anterior region were included in the study. The patients

who were presented during the study period and met selection criteria were recruited by non-probability consecutive sampling. Patients between the ages of 18-65, with enough bone volume, good oral hygiene, and good compliance with post-implant treatment were included. Uncontrolled systemic disease, heavy smoking history, active periodontal disease, untreated oral infection, pregnancy, immunocompromised status, inadequate bone volume requiring extensive grafting, incomplete records, and patient refusal for follow-up were all exclusion criteria.

Data Collection

Ethical approval and informed consent were obtained, and patients were randomly allocated to two groups based on implant timing. The patients in Group A were those who were immediately placed with an implant after tooth extraction, while patients in Group B were those who had a socket healing period before implant placement. The following demographic information, implant location, indication for removal, implant dimensions, bone quality and clinical data were documented. The patients were clinically and radiographically monitored to evaluate implant stability, peri-implant tissue status, marginal bone loss, esthetic result, complications and implant success.

Data Analysis

The data was entered and analyzed with the SPSS version 26.0. The quantitative variables were shown as mean $\pm$ SD and qualitative variables were shown as frequencies and percentages. Continuous variables were analysed using independent sample t-test and categorical variables using Chi-square test. Statistically significant was deemed at a p value of ≤ 0.05 .

RESULTS

Data were collected from 85 patients, with a mean age of 38.72 ± 10.54 years and a mean follow-up duration of 12.8 ± 1.9 months. Males were slightly more common, comprising 47 (55.3%) patients, while females accounted for 38 (44.7%). The central incisor was the most frequent missing tooth site, seen in 38 (44.7%) patients, followed by lateral incisor in 26 (30.6%) and canine in 21 (24.7%). The most common cause of tooth loss was caries/endodontic failure in 34 (40.0%) patients, followed by trauma in 29 (34.1%) and periodontal disease in 22 (25.9%).

Table 1. Baseline Demographic and Clinical Characteristics of Patients (n = 85)

Variable	Category	n (%) / Mean $\pm$ SD
Age (years)	Mean $\pm$ SD	38.72 $\pm$ 10.54
Gender	Male	47 (55.3%)
	Female	38 (44.7%)
Missing tooth site	Central incisor	38 (44.7%)
	Lateral incisor	26 (30.6%)
	Canine	21 (24.7%)
Cause of tooth loss	Trauma	29 (34.1%)
	Caries/endodontic failure	34 (40.0%)
	Periodontal disease	22 (25.9%)
Bone quality	Type II	31 (36.5%)
	Type III	42 (49.4%)
	Type IV	12 (14.1%)
Follow-up duration (months)	Mean $\pm$ SD	12.8 $\pm$ 1.9

The mean age was 37.91 $\pm$ 10.11 years in the immediate group and 39.51 $\pm$ 10.98 years in the delayed group ($p=0.487$). Male distribution was also similar, with 24 (57.1%) males in the immediate group and 23 (53.5%) in the delayed group ($p=0.738$). Central incisor

involvement, trauma-related extraction, Type II bone quality, implant length, and implant diameter showed no statistically significant differences between groups, with all p -values >0.05 .

Table 2. Comparison of Baseline Characteristics between Study Groups

Variable	Immediate Placement (N = 42)	Delayed Placement (N = 43)	P-Value
Age (years), Mean $\pm$ SD	37.91 $\pm$ 10.11	39.51 $\pm$ 10.98	0.487
Male gender, n (%)	24 (57.1%)	23 (53.5%)	0.738
Central incisor site, n (%)	19 (45.2%)	19 (44.2%)	0.921
Trauma-related extraction, n (%)	15 (35.7%)	14 (32.6%)	0.764
Bone quality Type II, n (%)	16 (38.1%)	15 (34.9%)	0.759
Implant length (mm), Mean $\pm$ SD	12.18 $\pm$ 1.09	12.04 $\pm$ 1.12	0.563
Implant diameter (mm), Mean $\pm$ SD	3.81 $\pm$ 0.31	3.77 $\pm$ 0.28	0.542

At 12 months, implant success was high in both groups, with 40 (95.2%) successful implants in the immediate placement group and 40 (93.0%) in the delayed placement group ($p=0.671$).

Implant Stability Quotient was slightly higher in the immediate group at 74.5 $\pm$ 4.2 compared with 72.9 $\pm$ 4.6 in the delayed group, but this was not statistically significant ($p=0.094$).

Table 3. Clinical and Radiographic Outcomes at 12 Months

Outcome Variable	Immediate Placement (N = 42)	Delayed Placement (N = 43)	P-Value
Implant success rate, n (%)	40 (95.2%)	40 (93.0%)	0.671
Implant Stability Quotient, Mean $\pm$ SD	74.5 $\pm$ 4.2	72.9 $\pm$ 4.6	0.094
Marginal bone loss (mm), Mean $\pm$ SD	0.68 $\pm$ 0.29	0.82 $\pm$ 0.34	0.043
Healthy peri-implant tissue, n (%)	38 (90.5%)	37 (86.0%)	0.516
Pink Esthetic Score, Mean $\pm$ SD	12.4 $\pm$ 1.7	11.3 $\pm$ 1.9	0.007

Early infection occurred in 2 (4.8%) patients in the immediate group and 3 (7.0%) in the

delayed group ($p=0.672$). Soft tissue recession was reported in 3 (7.1%) versus 5 (11.6%)

patients, while peri-implant mucositis occurred in 4 (9.5%) versus 6 (14.0%) patients in the immediate and delayed groups, respectively.

Table 4. Postoperative Complications and Implant Failures

Variable	Immediate Placement (N = 42)	Delayed Placement (N = 43)	P-Value
Early infection, n (%)	2 (4.8%)	3 (7.0%)	0.672
Soft tissue recession, n (%)	3 (7.1%)	5 (11.6%)	0.478
Peri-implant mucositis, n (%)	4 (9.5%)	6 (14.0%)	0.525
Implant failure, n (%)	2 (4.8%)	3 (7.0%)	0.671
Any complication, n (%)	9 (21.4%)	13 (30.2%)	0.355

Overall satisfaction was 9.1 ± 0.8 in the immediate group compared with 8.3 ± 1.1 in the delayed group ($p < 0.001$). Satisfaction with esthetics was also higher in the immediate

group at 9.3 ± 0.7 versus 8.4 ± 1.0 ($p < 0.001$), while satisfaction with treatment duration showed the largest difference, with scores of 9.4 ± 0.6 and 7.9 ± 1.2 , respectively ($p < 0.001$).

Table 5. Patient Satisfaction and Functional Outcomes

Variable	Immediate Placement (n = 42)	Delayed Placement (n = 43)	p-value
Overall satisfaction score, Mean $\pm$ SD	9.1 ± 0.8	8.3 ± 1.1	<0.001
Satisfaction with esthetics, Mean $\pm$ SD	9.3 ± 0.7	8.4 ± 1.0	<0.001
Satisfaction with treatment duration, Mean $\pm$ SD	9.4 ± 0.6	7.9 ± 1.2	<0.001
Masticatory function score, Mean $\pm$ SD	8.8 ± 0.9	8.5 ± 1.0	0.151
Would recommend procedure, n (%)	40 (95.2%)	38 (88.4%)	0.254

DISCUSSION

The present study aimed to analyse and compare the success rates of immediate and delayed implant placement in anterior teeth in the maxilla. The results showed a high success of both treatment protocols, with over 90% of the implants being successful at 12 months. The success rate for immediate implant placement was 95.2%, and 93.0% for delayed implant placement, which was not statistically different between the two groups ($p = 0.671$). When appropriate case selection and surgical protocols are used, immediate and delayed placement of implants have highly predictable results in the esthetic zone. There were no differences between the two groups in terms of demographic and baseline clinical parameters. The mean age of the children in the immediate placement group was 37.91 ± 10.11 years and in the delayed placement group was 39.51 ± 10.98 years. There were no significant

differences between groups in terms of gender, implant location, cause of implant loss, bone quality, implant length, or implant diameter [13]. This baseline comparability helps reduce the likelihood of factors other than the observed outcome differences creating a confounding effect, thereby increasing the validity of the outcome difference observed [14].

An important finding of the study was the similar survival and stability of implants in both techniques. However, the Implant Stability Quotient (ISQ) was slightly better in immediate placement group (74.5 ± 4.2) compared to the delayed placement group (72.9 ± 4.6); but the difference between the two was not statistically significant ($p = 0.094$). The results suggest that immediate implant placement can achieve primary and secondary stability like delayed placement provided sufficient bone support and primary fixation are achieved [15]. In addition, previous studies have found that immediate

implants placed in carefully selected extraction sites have high survival rates and good implant stability, which further illustrates that immediate implants do not negatively influence osseointegration. Preserving the marginal bone is a key factor in the success of the implant, especially in the anterior maxilla. The marginal bone loss was significantly lower in the immediate placement group (0.68 ± 0.29 mm) than in the delayed placement group (0.82 ± 0.34 mm) ($p=0.043$). This result could be explained by the fact that the immediate implant placement may lead to better preservation of alveolar bone architecture in comparison to the standard implant insertion [16]. Less remodelling may help to maintain peri-implant bone levels following extraction. Similar findings have been reported previously showing that immediate implant placement could help maintain ridge dimensions and minimize crestal bone loss in conjunction with the proper surgical procedures and grafting techniques. There were relatively few postoperative complications in either treatment group. 4.8% of immediate placement cases and 7.0% of delayed placement cases were infected early [17]. Seventy-one percent (7.1%) and eleven and six percent (11.6%) of patients had soft tissue recession and peri-implant mucositis, respectively. The rate of implant failures was also low, having only 4.8% in immediate placement and 7.0% in delayed placement. While not statistically significant, there may be fewer complications in the immediate placement group, due to the possible shorter duration of treatment and the maintenance of existing hard- and soft-tissue structures. Low complication rates have been found for both treatments with experienced clinicians as reported in the literature [18]. There was no difference in masticatory function scores between immediate placement and delayed placement (8.8 ± 0.9 and 8.5 ± 1.0 , respectively, $p=0.151$). Similarly, both patient groups were highly favourable towards the procedure, with 95.2% of patients in the immediate placement group and 88.4% of those in the delayed placement group saying they would recommend the procedure to others. The results showed that both treatments were able to restore oral function and were accepted by the patients [19,20].

LIMITATIONS

The study has some limitations that need to be considered when the results of the study are interpreted. The first is that the number of

patients was relatively small with just 85 patients included, meaning that the findings may not be applicable to larger populations. Second, a 12-month follow-up period was followed, and long-term outcomes, including implant survival and peri-implant bone stability and complications beyond 12 months, could not be evaluated. Third, the study took place at a single institution, and the results might not be applicable to other clinical settings in which patients have varying characteristics and treatment regimens. Fourth, the effects of patient compliance during follow-up, occlusal loading patterns, and oral hygiene practices and smoking may have affected the results of the implants and were not fully controlled. Multicenter randomized controlled trials with larger numbers of patients and longer follow-up periods are recommended to confirm the results of this study and generate a greater amount of evidence for the efficacy of immediate versus delayed implant placement in the maxillary anterior region in the long term.

CONCLUSION

The success rates and clinical outcomes were high and satisfactory for replacement of the anterior teeth in the maxilla for both immediate and delayed implant placement. The peri-implant tissue health around implants was similar for both options, but the placement of the implant immediately was found to cause significantly less MBL, better esthetic outcomes and higher patient satisfaction. The results indicate that it is a predictable and effective treatment for the proper patient, and that it has other benefits, including improved esthetic outcomes and shortened treatment time.

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