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Original Article

Comparison of Periodontal Indices in Immediate and Delayed Implants

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Abstract

Ideal implants should possess characteristics such as aesthetics, morphology similar to natural teeth, durability, and high strength. Unfortunately, these criteria are sometimes unmet, leading to complications with the implants used. Therefore, this study aimed to compare periodontal indices between immediate loading (IL) and conventional loading (CL) implants. This study included 50 patients with dental implants: 25 with immediate implants and 25 with delayed implants. Inclusion criteria were age over 20 years and willingness to receive implant treatment. Exclusion criteria included smoking, pregnancy or lactation, history of periodontal treatment in the last 3 months, diabetes, cardiovascular disease, cancer, or immune system deficiencies. Research tools included a demographic form and clinical records collected via a checklist following the acquisition of the institutional ethics code. Data collection involved visiting dental clinics and completing the designed checklist for consenting patients. The mean probing depth (PD) after 6 months of loading was significantly increased in the immediate implant group compared to the delayed implant group ($P < 0.01$). Based on the results, the mean keratinized tissue width (KTW) after 6 months of loading was significantly increased in the delayed implant group compared to the immediate implant group ($P < 0.05$). The bleeding on probing (BOP) results showed that 44% of patients with delayed implants experienced bleeding, while 76% of patients with immediate implants exhibited bleeding. Furthermore, patients receiving delayed implants had a lower frequency of bleeding upon probing compared to those receiving immediate implants. Regarding implant location, 56% of immediate implants were placed in the maxilla and 44% in the mandible, whereas 52% of delayed implants were placed in the mandible compared to 48% in the maxilla. The gingival bleeding rate was higher in immediate implants than in delayed implants, while the gingival width was greater in delayed implants than in immediate implants. Additionally, most patients with immediate implants were located in the maxilla, and most patients with delayed implants were in the mandible.

Keywords: Immediate Implant, Delayed Implant, Periodontal, Oral and Dental Diseases

Introduction

Humans lose their teeth for a variety of reasons, including dental caries, periodontal diseases, and trauma. In modern dentistry, dental implants have undergone remarkable advancements, leading to substantial improvements in the quality of treatment provided to patients [1–3]. One of the most common causes of tooth loss is periodontitis. For many years, dental implants have been considered the treatment of choice for the replacement of missing teeth, as they are surgically placed into the jawbone and serve as substitutes for lost natural teeth. Dental implants are metallic structures with biocompatible properties that are inserted into the jawbone beneath the gingiva and act

as functional and aesthetic substitutes for natural dentition [4–7].

In recent years, as the demand for implant-based restorations has increased, research has continued to identify the most suitable implant designs that can closely mimic natural dental tissues. Dental implants are widely used in dentistry due to their longevity and favorable success rates [8–10]. However, when a non-passive fit exists between the dental implant and the prosthesis, complications may occur—such as biological or mechanical issues including screw loosening or fracture, damage to soft and hard tissues, and increased plaque accumulation [11–13]. The growing popularity of implant-based therapy is also attributed to factors such as prolonged life expectancy, the rising elderly population, anatomical consequences of edentulism, poor performance of removable prostheses, psychological effects of tooth loss, and the predictable outcomes of implant-supported prostheses [14–16]. One important aspect of implant therapy is the accuracy of impression making, which is influenced by several factors including the impression technique, number of implants, operator skill, impression materials, type of impression tray, and method of connecting the implants [13,17,18].

From a timing perspective, several classifications have been proposed regarding the interval between tooth extraction and implant placement. These include: 1) immediate implantation (within 48 hours after extraction), 2) early implantation (4–8 weeks post-extraction), 3) delayed implantation (12–16 weeks post-extraction), and 4) late implantation (more than 16 weeks after tooth removal) [19–21]. An ideal dental implant should demonstrate aesthetic excellence, natural tooth-like morphology, durability, and mechanical strength. However, in some cases, failure to meet these standards results in complications that can be categorized as mechanical or biological. Mechanical complications may include loosening or detachment of the implant crown, while biological complications involve peri-implant soft or hard tissue diseases, excessive bone loading, bone resorption, and microflora proliferation [22,23]. A primary advantage of immediate implants lies in the immediate placement of the fixture following tooth extraction, which significantly reduces the overall treatment time. Because the implant is placed at the time of extraction, bone healing begins directly around the implant, resulting in more physiological and favorable bone regeneration. Studies on both one-stage and two-stage implant systems have reported high success rates in immediate placement protocols [21,24–26]. Besides shorter treatment duration, immediate implantation offers other advantages such as preservation of soft and hard tissues. Since the surgical and loading procedures occur during the same session, this approach minimizes surgical trauma compared with the conventional (two- or three-stage) protocol. Other benefits of immediate implant placement include the preservation of aesthetics, maintenance of alveolar ridge height and width, improved quality of life, and enhanced patient satisfaction [27]. Given the clinical significance of implant therapy in promoting oral health and preventing periodontal complications, the present study was designed to compare periodontal indices between immediate and delayed dental implants in patients from Ilam City.

Materials and Methods

This study included a total of 50 patients with dental implants, consisting of 25 individuals with immediate implants and 25 with delayed implants.

Participant Selection Criteria

Inclusion Criteria

Participants were required to be ≥ 20 years of age and provide informed consent for participation in the dental implant therapy protocol.

Exclusion Criteria

Individuals presenting with any of the following conditions were excluded from the study: current tobacco use, current pregnancy or lactation, history of periodontal therapy within the preceding three months, a confirmed diagnosis of diabetes mellitus, presence of cardiovascular diseases, history of malignancy, or any diagnosed immune system dysregulation. The research instrument consisted of a demographic and clinical data form, which was filled out based on information extracted from the patients' dental records using a pre-designed checklist. Following approval of the ethics code, the researchers collected data by visiting dental clinics and reviewing the clinical files of the patients who met the inclusion criteria. The checklist was designed using the expertise of faculty members from the School of Dentistry, and its validity was also confirmed.

Ethical Compliance

The ethical framework for this investigation was predicated on adherence to three core principles: prohibition of any financial burden imposed upon the subjects, strict maintenance of patient confidentiality regarding all private information, and guarantee of voluntary participation or non-participation throughout the study duration. The study procedure involved enrolling patients who presented for implant therapy at dental offices. After obtaining informed consent, eligible patients were included in the study. Ethical principles and guidelines approved by the university ethics committee were strictly observed throughout the research process. Data analysis was performed using SPSS version 19. Descriptive and inferential statistical methods—including mean, standard deviation, and variance analyses—were applied, and results were analyzed at a significance level of 0.05.

Results

Demographic Characteristics

Descriptive statistics of the participants showed that the mean age of the patients who received immediate implants was 45.83 ± 12.8 years, whereas it was 26.83 ± 10.9 years in the delayed implant group. In the immediate group, 56% were male and 44% female, while in the delayed group 68% were male and 32% female (Table 1).

Implant Probing Depth

The mean probing depth after six months of loading in the immediate implant group showed a statistically significant increase compared with the delayed implant group ($P < 0.01$). The mean ± SD of probing depth in patients with immediate implants was 2.84 ± 0.89 mm, while in those with delayed implants it was 2.76 ± 0.86 mm (Table 2).

Table 1. Demographic characteristics of patients participating in the study

Variable	Groups	Immediate implant	Delayed implant
Age (years)	Mean ± SD	45.82 ± 13.8	46.83 ± 10.9
Gender	Male	56 %	68 %
	Female	44 %	32 %
Residence	Urban	78 %	84 %
	Rural	22 %	16 %
Education	Illiterate	11 %	11 %
	Primary	44 %	55 %
	University	45 %	32 %

Table 2. Implant probing depth status in patients

Variable	Groups	Mean ± SD (mm)	Variance	Significance (*P*)
Probing depth	Immediate implant	2.84 ± 0.89	1.41	0.029
	Delayed implant	2.76 ± 0.86	0.742	0.003

Gingival Width

According to the findings, the mean gingival width after six months of loading was significantly higher in the delayed implant group compared with the immediate implant group ($P < 0.05$). The mean ± SD gingival width in patients with immediate implants was 4.6 ± 1.69 mm, while in the delayed implants group it was 5.8 ± 1.85 mm (Table 3).

Bleeding During Probing

The results of gingival bleeding during probing showed that among patients with delayed implants, 44% exhibited bleeding and 56% had no bleeding. In contrast, 76% of patients with immediate implants demonstrated bleeding and 24% had no bleeding during probing. Thus, bleeding during probing was greater in immediate implant cases compared with delayed implant cases (Table 4).

Implant Location

The results regarding implant placement demonstrated that 56% of immediate implants were placed in the maxilla, whereas 44% were placed in the mandible. On the other hand, 48% of delayed implants were located in the maxilla and 52% in the mandible (Table 5).

Discussion

Since the introduction of dental implants, various techniques and commercial brands have been developed over time, each offering specific surgical instruments and methods to encourage clinicians toward achieving better clinical outcomes. The choice of implant depends on several factors such as the pattern of edentulism, available prosthetic space, emergence profile, and the remaining bone volume [28,29]. One of the common complications following dental implant placement is the occurrence of periodontal-related diseases. Periodontitis is a chronic bacterial infection that significantly affects general health. Certain shared risk factors may predispose individuals to both periodontal disease and cardiovascular disorders, including age, gender, tobacco use, diabetes, and behavioral factors [30–32]. Post-surgical bacterial contamination and infections may delay wound healing and cause inflammatory responses, hypersensitivity, pain, and plaque accumulation at the surgical site. Reduction of dental plaque has been shown to accelerate periodontal wound healing and reduce postoperative complications compared to cases with heavy plaque accumulation [33].

Esfahanian *et al.* conducted a study aimed at evaluating the relationship between periodontal indices and keratinized tissue width. In their study, 90 patients with fixed implant-supported prostheses were divided into three groups of 30 subjects each. Periodontal examinations were conducted for all participants, and indices including KM, AM, PD, BOP, GR, and GI were measured. According to their findings, a significant inverse correlation was found between KM and AM in all three groups as well as between PD and KM in the bridge group [34]. In another study by Rokn *et al.*, which compared gingival health indices between smokers and non-smokers with dental implants, a total of 36 patients were evaluated.

Table 3. Gingival width of implants among patients

Variable	Groups	Mean ± SD (mm)	Variance	Significance (*P*)
Gingival width	Immediate implant	4.6 ± 1.69	2.88	0.05
	Delayed implant	5.8 ± 1.85	0.64	0.05

Table 4. Frequency of bleeding during probing among patients

Variable	Group	With bleeding (%)	Without bleeding (%)	*P*-value
Gingival bleeding	Delayed implant	11 (44%)	14 (56%)	0.004
	Immediate implant	19 (76%)	6 (24%)	0.001

Table 5. Distribution of implant placement in patients

Variable	Group	Maxilla (%)	Mandible (%)	*P*-value
Implant location	Immediate implant	14 (56%)	11 (44%)	0.02
	Delayed implant	12 (48%)	13 (52%)	0.001

The implants were categorized into two groups: 60 implants in non-smokers and 30 implants in smokers. The results indicated a significant relationship between different levels of BOP and PPD with smoking status. Therefore, due to the negative impact of smoking, preventive measures against tobacco use should be emphasized [35]. Smoking has been identified as a predisposing factor leading to higher implant failure rates. Moreover, smokers show a higher incidence of infections compared with non-smokers; their treatment procedures tend to be more challenging, and periodontal diseases are more commonly reported in this group [36,37].

In the study by Mittal *et al.*, 40 dental implants were placed—20 of the "rest" type and 20 of the "tapered" type. A significant difference was observed between the two groups regarding the quality of osseointegration [37]. Additionally, in a study by Muthaiyan *et al.*, 14 patients were included: 7 in the delayed group and 7 in the immediate group. Clinical assessments were performed at baseline and at 3 and 6 months postoperatively. The results demonstrated no significant differences in probing depth, plaque index, or probing-related indices at any time point. However, a significant difference in implant stability quotient values was observed, supporting a preference for delayed implants [38].

A meta-analysis by Heidari *et al.* examined 61 studies comparing conventional loading (CL) and immediate loading (IL) of dental implants. The cumulative risk ratio was 0.78, indicating that the pooled relative risk of survival for immediate-loading implants was 0.78 compared with conventionally loaded implants. The mean marginal bone loss (MBL) in the IL group was 0.32 mm greater than that in the CL group—a statistically significant difference. Regarding probing pocket depth (PPD), IL implants showed 0.25 mm less depth compared to CL implants. Although minor survival differences were observed between immediate and conventional loading, these were not statistically significant [39]. Given its clinical advantages—elimination of a second surgical step, reduced treatment time, early maturation of soft tissue prior to final prosthesis fabrication, avoidance of temporary removable prostheses, immediate function, enhanced patient satisfaction, and improved bone stability—immediate implant loading has increasingly gained popularity [3,40]. Regarding periodontal indicators in modern clinical settings, the focus is more on indicators that denote the state of active inflammation and the extent of permanent destruction: BOP (Bleeding on Probing):

indicates active inflammation and the need for immediate treatment. CAL (Clinical Attachment Loss): indicates the extent of permanent destruction and disease progression [41,42].

Conclusion

The amount of gingival bleeding was found to be higher in immediate implants compared with delayed implants, whereas the width of keratinized gingiva was greater in delayed implants. Moreover, most immediate implants were placed in the maxilla, while most delayed implants were located in the mandible.

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Conflict of Interest

No conflicts of interest were reported by the authors in this work.

Ethical Considerations

The Ethics Committee of Ilam University of Medical Sciences, Ilam, Iran approved the present study (IR.MEDILAM.REC.1402.043).

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