

Clinical and Radiographic Comparison of Autogenous Dentin Graft and Allograft Combined with Platelet-Rich Fibrin in Immediate Dental Implant Placement: A Randomized Controlled Trial

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ABSTRACT

To compare the clinical and radiographic results of autogenous dentin graft & allograft, both combined with platelet-rich fibrin (PRF) membrane, in the immediate placement of dental implants. Twenty patients who require extraction of non-restorable teeth and immediate implant placement were randomly allocated into two equal groups (n = 10). The peri-implant gap was grafted with either autogenous dentin particles (Dentin group) or allograft (Allograft group), followed by coverage with a PRF membrane. Clinical evaluation included implant stability quotient (ISQ) and peri-implant probing depth (PPD). Radiographic assessment comprised marginal bone level and peri-implant bone density measurements. Follow-up evaluations were performed up to 12 months postoperatively. All implants survived throughout the study period, yielding a 100% survival rate. The dentin group demonstrated significantly lower PPD values than the allograft group at three months (P equal 0.009), six months (P equal 0.014), and twelve months (P equal 0.019). Although insignificant intergroup variations were observed in bone density at any evaluation period (P above 0.05), the dentin group showed a significant rise in bone density over time (P under 0.001). Marginal bone loss was significantly reduced in the dentin group at six months (P under 0.001) & twelve months (P equal 0.003). Autogenous dentin graft combined with PRF provides favorable peri-implant tissue healing, enhanced bone maturation, and superior marginal bone preservation compared with allograft in immediately placed dental implants. It represents a biologically effective and clinically predictable alternative for managing peri-implant defects.

Keywords: Immediate implant placement; autogenous dentin graft; allograft; platelet-rich fibrin; bone density

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INTRODUCTION

Immediate implant placement, known as a dental implant that is inserted immediately following tooth extraction, has emerged as a predictable and efficient treatment modality in implant dentistry. This approach offers several benefits, involving diminished surgical interventions, shorter management time, preservation of alveolar ridge dimensions, and enhanced esthetic outcomes 1,2. Moreover, immediate implant placement has been correlated with great patient satisfaction and survival rates commensurate with those of delayed implant protocols 3. Despite these benefits, physiologic post-extraction bone remodeling remains a concern and may adversely affect peri-implant tissue stability 4. Therefore, adjunctive regenerative procedures have been advocated to enhance bone preservation and optimize clinical outcomes following immediate implant placement.

Bone grafting is essential for the immediate implantation of implants by enhancing peri-implant bone regeneration, minimizing post-extraction ridge resorption, and promoting favorable osseointegration 5,6. A variety of grafting

materials, involving allografts, xenografts, autogenous grafts, and synthetic substitutes, have been successfully used to augment peri-implant defects and support implant stability 7. One of the most significant obstacles in immediate implant placement is the selection of an appropriate graft material. Despite the fact that autogenous bone is regarded as the gold standard, its utilization is restricted by donor-site complication, increased surgical time, and limited availability 8. Allografts & xenografts eliminate the need for a second surgical site but may exhibit slower remodeling and integration 9. Moreover, regardless of the graft material utilized, clinicians must overcome challenges related to primary implant stability, peri-implant gap management, and post-extraction bone remodeling, all of which may influence long-term implant success and esthetic outcomes 3. Consequently, there is growing interest in biologically active alternatives, such as autogenous dentin grafts, that may provide effective regeneration while avoiding the limitations of conventional grafting materials. Allografts are beneficial in immediate implants owing to their capacity to improve bone & soft tissue support,

preserve socket structure, and provide predictable clinical outcomes, making them a valuable option in modern dental implantology 3. The main challenges of using allografts in immediate dental implants are concerns about antigenicity, risk of disease transmission, and lack of clinician familiarity with their use 10. These factors can impact the safety and effectiveness of allograft materials in immediate implant procedures. Other general challenges, such as achieving optimal osseointegration and managing the residual gap, are also relevant but not unique to allografts 11. Thus, while allografts remain a valid and predictable option, autogenous dentin offers a biologically driven alternative that may shorten the maturation window and enhance bone preservation during the critical first year of implant loading. Autogenous dentin grafts have emerged as a promising biomaterial for immediate implant placement due to their similarity to alveolar bone and favorable regenerative properties 12. Dentin contains a collagen-rich matrix and bioactive growth factors that support osteoconduction, osteoinduction, bone formation, and osseointegration 13. As an autologous graft, it eliminates the risks of disease transmission, immunologic reactions, and donor-site complication 14. Clinical studies have demonstrated favorable bone regeneration, graft integration, alveolar ridge preservation, and implant survival rates comparable to conventional grafting materials 12. Moreover, its immediate chairside preparation makes autogenous dentin a cost-effective and clinically predictable option for managing peri-implant defects 15.

Platelet-rich fibrin is a second-generation autologous platelet concentrate prepared without anticoagulants. PRF consists of a fibrin matrix enriched with platelets, leukocytes, and numerous growth factors, involving platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor- β (TGF- β) 16. These biologically active mediators promote angiogenesis, cell proliferation, soft tissue healing, and bone regeneration 17. Consequently, platelet-rich fibrin has been widely utilized in implant dentistry to enhance wound healing, accelerate osseointegration, and improve both hard- and soft-tissue outcomes 18.

Although the regenerative potential of autogenous dentin grafts, allografts, and platelet-rich fibrin has been extensively investigated individually, limited clinical evidence exists regarding their use in combination for the management of peri-implant defects correlated with immediate implant placement. Furthermore, only a few studies have comprehensively assessed the clinical and radiographic results of autogenous dentin grafts in comparison with conventional allograft materials.

The null hypothesis was that treatment with autogenous dentin graft and allograft regarding peri-implant tissue healing was the same following immediate implant placement. The specific object of this object was to compare the efficacy of autogenous dentin graft & allograft on immediately placed dental implants through clinical and radiographic evaluations.

PATIENTS AND METHODS

In this prospective randomized clinical trial, twenty cases were included, with a mean age of 35.5 ± 3 years (range: 30 to 40 years). Twelve of the cases were female, while eight were male. The Outpatient Clinic of the Oral Medicine and Periodontology Department, Faculty of Dental Medicine, Al-Azhar University, Assiut Branch, was the site of participant recruitment. The Institutional Research Ethics Committee of the Faculty of Dental Medicine, Al-Azhar University, Assiut Branch, granted ethical approval (Approval No. AUAREC20220003-11). Prior to enrollment, all participants were granted written informed consent. To be involved in the research sample, the cases had to be free from any systemic diseases, non-smokers, not pregnant. In addition, they had to have non-restorable teeth indicated for extraction and immediate implant placement due to endodontic failure, root fracture, root resorption, or advanced periodontal disease. Finally, Presence of a thin buccal bone plate with bone density corresponding to D3 or D4 bone quality and a horizontal peri-implant gap (jumping distance) of ≥ 1.5 mm.

All patients presented with Information collected from the questionnaire was handled with confidentiality and used for research purpose only. Before the surgical procedure, each patient provided written informed assent.

Sample Size Calculation

A power analysis was conducted based on previously published data on radiographic hard-tissue changes around immediate implants. Using the effect size reported by Mizar et al. 19 (Cohen's $d = 1.86$), a two-sided α of 0.05, and equal group allocation, a sample of 20 participants (10 per group) was estimated to have a power of 80.00% to identify a significant difference between groups.

Randomization and Allocation

Cases were randomly assigned to one of two equal groups utilizing a computer-generated randomization sequence (www.randomizer.org). Allocation concealment was achieved utilizing sealed opaque envelopes. Both the participants and the outcome assessor were blinded to the group assignment throughout the study.

Preoperative Evaluation and Assessment

We obtained a thorough medical and dental history, which was followed by intraoral and extraoral examinations. An evaluation was conducted to confirm the absence of acute infection in the tooth that was recommended for extraction and immediate implant placement. Occlusion, restorative space, and tooth position were also evaluated. Standardized clinical photographs were taken preoperatively and throughout the treatment period.

Radiographic Assessment

Periapical X-ray films (pre and postoperative Fig. 1 and 2) and CBCT scans were obtained for all patients using a Sirona Cone Beam 3D system (90 kV, 10 mA, 18×20.6 cm FOV, 300 μ m voxel size). The scans were used for implant planning and assessment of bone dimensions, bone quality, and determination of the appropriate implant position, length, and diameter.

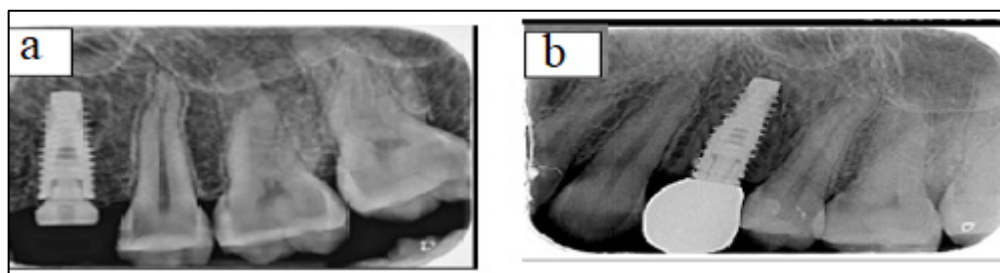


Fig. 1. Radiographic Evaluation of the Dentin Graft Group. Sagittal view: a: Baseline. b: Post operative

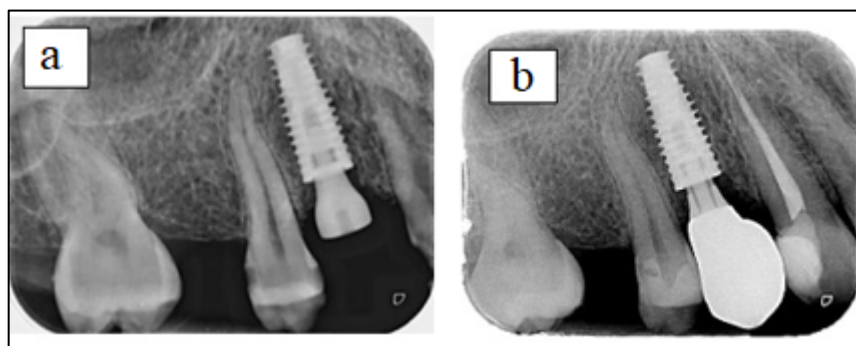


Fig. 2. Radiographic Evaluation of the Allograft Group. Sagittal view: a: Baseline. b: Post operative

Surgical Procedure

The extraction sockets were classified according to the Salama and Salama classification and only Type I extraction sites were included in the study. Teeth indicated for extraction due to endodontic failure, root fracture, root resorption, or advanced periodontal destruction were selected for immediate implant placement.

Following local anesthesia using 4% articaine hydrochloride with epinephrine (1:100,000), a sulcular incision was performed, with vertical releasing incisions added when required. Atraumatic tooth extraction was done utilizing periostomes and extraction forceps to preserve the integrity of the socket walls and surrounding soft tissues. The extraction sockets were thoroughly debrided to remove periodontal ligament remnants and granulation tissue and subsequently irrigated with sterile saline solution.

Implant osteotomy preparation was initiated approximately 3 mm beyond the root apex and oriented toward the palatal socket wall to maximize primary stability while preserving the buccal plate. The preoperative CBCT analysis was used to determine the implant dimensions. The implant platform was positioned approximately three millimeters apical to the cemento-enamel junction of the adjacent teeth, with the implants being placed in a prosthetically driven position. Utilizing insertion torque and resonance frequency analysis (Osstell®, Gothenburg, Sweden), primary stability was attained and documented as the Implant Stability Quotient (ISQ).

The peri-implant gap (jumping distance ≥ 1.5 mm) was grafted according to the allocated treatment group. In Group I, autogenous dentin graft was hydrated with sterile saline and packed into the peri-implant defect, whereas in Group II, particulate allograft was similarly prepared and applied. In both groups, the graft material was covered with a

platelet-rich fibrin membrane. The membrane was stabilized around the healing abutment, which was installed immediately to facilitate transmucosal healing and subsequent clinical and biochemical assessments (Fig. 3a-f, 4a-f).

Primary wound closure was achieved utilizing interrupted 4-0 non-resorbable sutures.

Group 1: Preparation of Autogenous Dentin Graft

Following atraumatic tooth extraction, the extracted tooth was cleaned with sterile saline, & all restorations, cementum, carious lesions, pulp tissue, periodontal ligament remnants, and calculus deposits were removed. The tooth was then processed into particulate dentin using a sterile titanium bone crusher. The particles were disinfected in seventy percent ethanol and five percent peracetic acid for ten minutes, followed by demineralization in 2% nitric acid for 20 minutes. Finally, the graft material was rinsed twice with phosphate-buffered saline to restore physiologic pH & was immediately used for grafting the peri-implant gap.

Group 2: Allograft Material

Demineralized freeze-dried bone allograft (DFDBA) (LYOPlast®, Russia; Trade Egypt Co., Egypt) was used in this study.

For both groups: Preparation of Platelet-Rich Fibrin (PRF) Membrane

PRF was prepared in line with Dohan Ehrenfest et al., (2010). Ten milliliters of venous blood were collected in sterile tubes without anticoagulant and centrifuged at 3000 rpm for twelve minutes. The resulting platelet-rich fibrin clot was isolated from the middle layer and gently compressed to produce a standardized PRF membrane for clinical application.

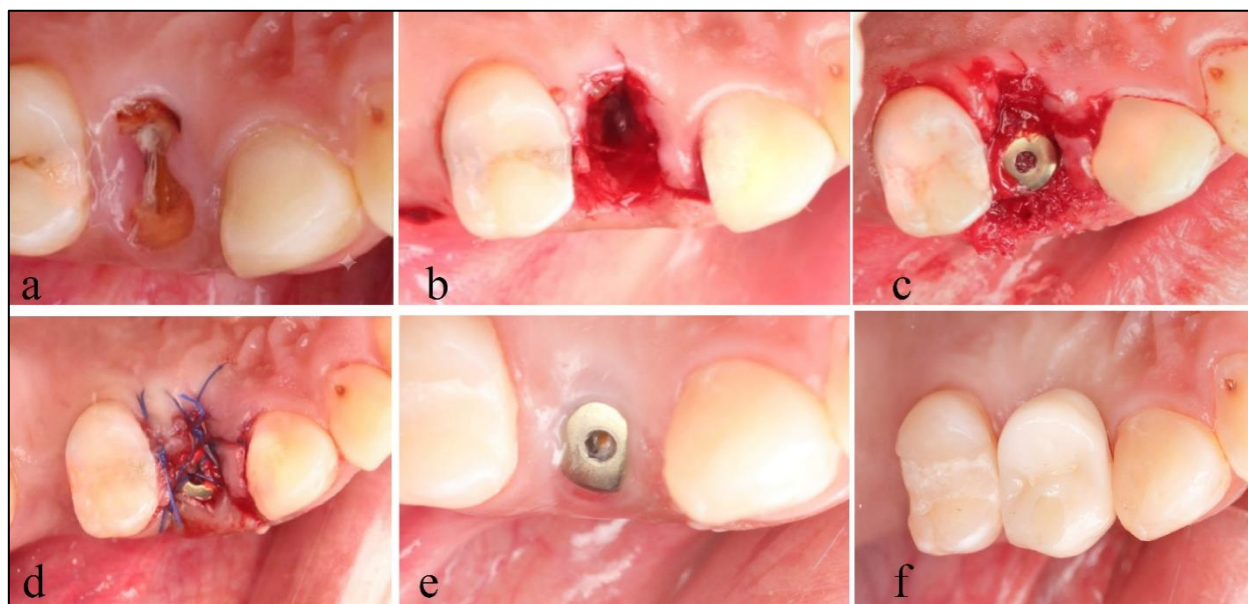


Fig. 3: Showing Group 1: Dentin graft and PRF membrane. a: Preoperative. b: Tooth extraction. c: Application of graft and PRF membrane. d: Suturing. e: Healing after 3 months. f: Final zirconium restoration.

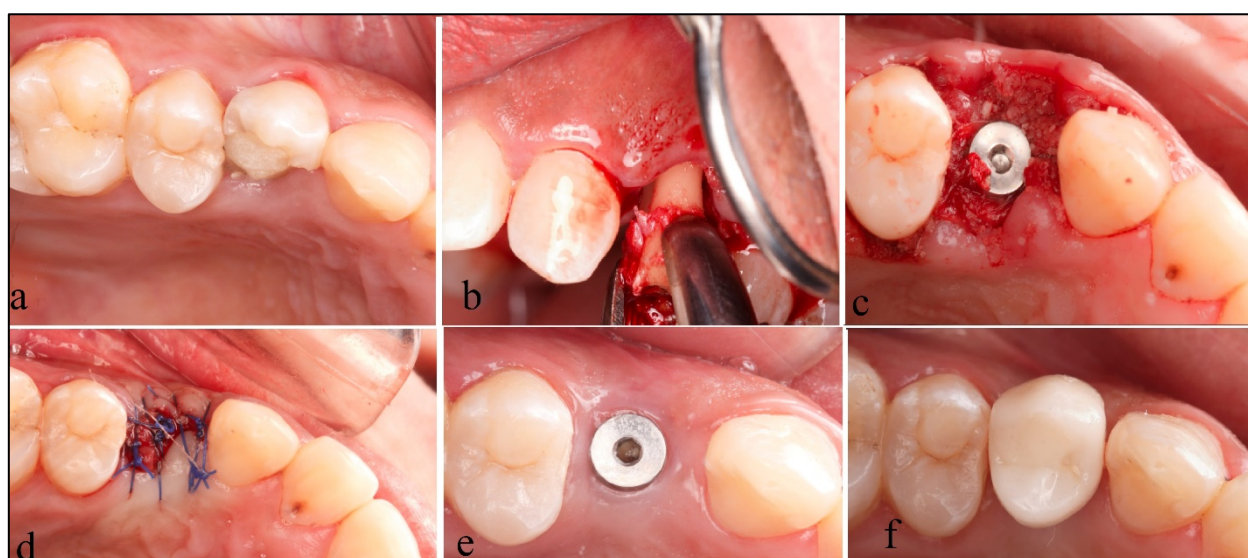


Fig. 4: Showing Group 2: Allograft and PRF membrane. a: Preoperative. b: Tooth extraction. c: Application of graft and PRF membrane. d: Suturing. e: Healing after 3 months. f: Final zirconium restoration.

Postoperative medications:

Oral hygiene instructions were administered to all cases, and it was recommended that the surgical site not be loaded for a period of six weeks. Amoxicillin/clavulanic acid (one gram every twelve hours for five days), diclofenac potassium (50 mg every eight hours for three days), and 0.12% chlorhexidine mouthwash twice daily for two weeks comprised the postoperative medications. After a period of seven to ten days, the sutures were extracted.

Prosthetic Phase

After a three months healing period, digital impressions were obtained using an intraoral scanner and scan bodies. Definitive zirconia restorations were designed using CAD/CAM technology based on implant position, opposing arch records, and interocclusal relationships.

Following verification of passive fit, marginal adaptation, proximal contacts, and occlusion, the final restorations were delivered. Prosthetic screws were torqued in line with the manufacturer's recommendations, & the screw-access channels were sealed prior to restoration delivery.

Clinical Evaluation

Resonance frequency analysis (Osstell®) was employed to assess implant stability at three months postoperatively and immediately following implant implantation. The average of three measurements was used to calculate the ISQ values for each implant.

Peri-implant probing depth (PPD) was measured using a plastic periodontal probe at six sites per implant with a standardized probing force (≈ 0.15 N). The mean value of the six measurements was recorded in millimeters.

Radiographic Evaluation

Marginal bone levels were evaluated utilizing standardized digital periapical radiographs taken immediately after implant placement and at six & twelve months postoperatively. Measurements were recorded from the implant shoulder to the most coronal bone-to-implant contact on the mesial and distal surfaces, and the mean value was calculated (Fig. 3 and 4).

Peri-implant bone density was evaluated using CBCT. Measurements were obtained at the coronal, middle, and apical thirds of the peri-implant bone, 1 mm from the implant surface. The mean value was recorded and expressed in Hounsfield units (HU).

Statistical Analysis:

IBM SPSS Statistics for Windows (Version 23.0; IBM Corp., Armonk, NY, USA) was employed to analyze the data. The Shapiro-Wilk and Kolmogorov-Smirnov tests were employed to assess the normality of the data distribution. Quantitative data were presented as the mean $\pm$ standard deviation for variables that were normally distributed and as the median (range) for variables that were non-normally distributed. Intergroup comparisons were performed utilizing the independent samples t-test for

parametric data and the Mann-Whitney U test for non-parametric data. Changes over time within each group were analyzed using repeated-measures ANOVA for parametric data and Friedman's test for non-parametric data. Bonferroni and Dunn's post hoc tests were applied for pairwise comparisons when appropriate. Correlations between variables were assessed utilizing Spearman's correlation coefficient. Statistical significance was set at P is less than or equal to 0.05.

RESULTS

Implant stability (ISQ %)

Table 1, shows the ISQ values in both groups. No statistically significant differences were observed among the dentin & allograft groups at baseline (P equal 0.378) or after 3 months (P equal 0.718). Within-group analysis revealed a significant rise in implant stability in the dentin group from baseline to 3 months (P < 0.001; partial Eta squared = 0.674), whereas insignificant change was detected in the allograft group. These results suggest that both groups achieved favorable implant stability, with greater improvement observed in the dentin graft group.

Table 1. Comparative analysis of implant stability (ISQ %) among the two groups and across different time points within each group, presented as descriptive statistics and repeated-measures ANOVA results.

Time	Dentin (n = 10)		Allograft (n = 10)		P-value	Effect size (Partial Eta squared)
	Mean	SD	Mean	SD		
Base line	79.2	6.7	81.8	6.14	0.378	0.044
3 months	80.8	6.01	81.8	6.16	0.718	0.007
P-value	<0.001*		1			
Effect size (Partial Eta squared)	0.674		0			

*: Significant at P is less than or equal to 0.05, Different superscripts within the same column indicate statistically significant change by time

2. Peri-Implant Probing Depth (PPD)

As shown in Table 2, the dentin group demonstrated significantly lower peri-implant probing depth values than the allograft group at three months (P equal 0.009), six months (P equal 0.014), and twelve months (P equal 0.019). Both groups demonstrated a significant reduction in PPD over time (P under 0.001). The decrease was more pronounced in the dentin group, suggesting superior peri-implant soft tissue outcomes compared with the allograft group.

Bone density (HU)

As shown in Table 3, no statistically significant differences in peri-implant bone density were observed among the dentin and allograft groups at baseline, six months, or twelve months (P above 0.05). However, the dentin group demonstrated a significant rise in bone density over time (P under 0.001; partial Eta squared = 0.903), while the allograft group exhibited no significant temporal changes (P = 0.087). These results suggest enhanced bone maturation in the dentin graft group during the follow-up interval.

Table 2. Descriptive data and repeated-measures ANOVA findings for peri-implant pocket depth (mm), illustrating differences between the study groups and changes observed within each group over time

Time	Dentin (n = 10)		Allograft (n = 10)		P-value	Effect size (Partial Eta squared)
	Mean	SD	Mean	SD		
three months	3.62 ^A	0.70	4.42 ^A	0.54	0.008*	0.33
six months	2.25 ^B	0.33	2.61 ^B	0.36	0.012*	0.294
twelve months	1.99 ^C	0.26	2.43 ^C	0.49	0.017*	0.25
P-value	<0.001*		<0.001*			
Effect size (Partial Eta squared)	0.712		0.791			

Marginal bone level (mm)

As shown in Table 4, insignificant difference in marginal bone level was observed among 2 groups at baseline ($P = 1.000$). However, the dentin group demonstrated significantly reduced in marginal bone loss compared to the allograft group at both six months (P under 0.001) & twelve

months (P equal 0.004). Significant changes over time were observed within both groups (P under 0.001). The dentin graft group exhibited superior marginal bone preservation throughout the follow-up interval.

Table 3. Statistical evaluation of bone density (HU) in the two study groups, including descriptive measures and repeated-measures ANOVA outcomes for both intergroup comparisons and intragroup changes throughout the study period.

Time	Dentin (number = 10)		Allograft (number = 10)		P-value	Effect size (Partial Eta squared)
	Mean	SD	Mean	SD		
Base line	723.12 ^C	88.30	720.50	89.92	0.948	0.0003
6 months	726.90 ^B	88.32	721.31	89.84	0.892	0.001
12 months	728.63 ^A	88.90	721.30	89.80	0.857	0.004
P-value	<0.001*		0.087			
Effect size (Partial Eta squared)	0.903		0.252			

Table 4. Statistical analysis of marginal bone level (millimeter) in the 2 groups, presenting descriptive measures and repeated-measures ANOVA outcomes for both intergroup comparisons and intragroup variations throughout the study period.

Time	Dentin (number = 10)		Allograft (number = 10)		P-value	Effect size (Partial Eta squared)
	Mean	SD	Mean	SD		
Base line	4.60 ^A	0.50	4.62 ^A	0.51	1	0
6 months	1.40 ^B	0.53	2.50 ^B	0.54	<0.001*	0.551
12 months	1.32 ^B	0.50	2.13 ^C	0.58	0.004*	0.40
P-value	<0.001*		<0.001*			
Effect size (Partial Eta squared)	0.975		0.952			

DISCUSSION

Immediate implant insertion is favored in rehabilitation because it offers faster, less invasive, and equally successful outcomes compared to traditional approaches. With added benefits of improved patient satisfaction and potential cost savings 1,22. Maxillary immediate implants are challenged by poor bone quality, high esthetic demands, anatomical limitations, soft tissue management issues, and the need for precise technique and planning 23. These factors make achieving predictable and satisfactory outcomes more difficult compared to other regions 24. This research was objected to assess clinical & radiographic efficacy of an autogenous dentin graft combined with a platelet-rich fibrin membrane in immediately placed dental implants.

A dentin graft offers several advantages when used in immediate dental implant procedures, particularly in fresh extraction sockets due to its biological compatibility 25. Immediate implant placement often leaves a gap (the “jumping distance”) among the implant & the socket wall. Dentin grafts help fill this space, promoting bone regeneration and reducing the risk of bone resorption, which is critical for implant stability and long-term success

26. In addition, extracted teeth can be processed into bacteria-free particulate dentin using specialized equipment (e.g., a dentin grinder) and immediately grafted into the extraction site, making the procedure efficient and practical 27.

Platelet-rich fibrin (PRF) membranes offer several advantages when used in immediate dental implant procedures. This is owing to their ability to improve healing, improve implant stability, decrease complications, and support the formation of healthy soft tissue, all with a high degree of safety and biocompatibility 18,28.

The cumulative survival rate was hundred percent, as all implants remained functional and free of failure during the follow-up. This success can be linked to appropriate patient selection, adequate plaque control, and meticulous surgical management.

The results of the research recommend that both grafting materials supported clinically acceptable implant stability over time. Our findings imply that, although both materials facilitated osseointegration, the dentin graft was associated with a more pronounced gain in implant stability during early healing. This differential response may reflect the

osteoinductive potential of autogenous dentin, which provides a native collagen matrix and endogenous growth factors that support bone remodeling and functional ankylosis 29. The stability trajectory observed here aligns with previous reports demonstrating superior or comparable implant stability when dentin grafts are used in extraction sockets or peri-implant defects compared with conventional xenografts or allografts 17,30. Dentin grafts are often autogenous (from the patient's own extracted teeth), reducing the risk of immune reaction & improving biocompatibility, which can enhance implant stability. Allografts, being from donor tissue, may carry risks of immune response and slower integration 25.

This study assessed peri-implant pocket depth (PPD) alterations over a 12-month follow-up period subsequent to augmentation with either autogenous dentin graft or allograft material. Notably, both groups exhibited a consistent and significant reduction in PPD over time, indicating the efficacy of both grafting materials in fostering peri-implant tissue stability. The continuous reduction in PPD observed in both groups may be attributed to the establishment of a stable peri-implant soft tissue seal & gradual maturation of the peri-implant tissues during healing 31. Previous researches have demonstrated that successful implant osseointegration is commonly correlated with a reduction in peri-implant inflammatory parameters and improvement in soft tissue adaptation over time 32. Mahardawi et al. (2023), in a systematic review and meta-analysis of RCTs, found that autogenous dentin grafts yielded implant survival ($\approx 97\%$) and marginal bone loss comparable to Bio-Oss/xenograft controls. However, direct PPD trajectories were not pooled. Regarding allografts, demineralized freeze-dried bone allograft (DFDBA) remains a validated comparator in periodontal and peri-implant defects, with PD reductions in the 2–4 mm range reported in regenerative trials 34, which is congruent with the 2.0–2.4 mm net PPD drop observed in our Allograft arm from 3 to 12 months.

Assessment of peri-implant bone density provides valuable information regarding the quality of newly formed bone and the progression of osseointegration. In the current research, both dentin grafts and allografts appear to maintain or improve peri-implant bone density, supporting successful osseointegration and bone regeneration. The available evidence suggests these graft materials are suitable for clinical use, especially in cases requiring bone augmentation around dental implants 35,36. Also, our findings suggest that autogenous dentin grafting may facilitate more effective peri-implant bone maturation during the healing period. This result agrees with previous studies comparing dentin grafts to other graft materials (such as xenografts), which found that dentin grafts provide similar results in terms of peri-implant bone regeneration and radiographic bone density 12. The use of autogenous tooth grafts combined with platelet-rich fibrin (PRF) has also been shown to enhance bone healing in peri-implant defects, further supporting the positive influence of dentin-derived materials on peri-implant bone density 16. The enhanced bone density observed in the dentin group may be attributed to the unique biological composition of

dentin, which closely resembles that of alveolar bone in both inorganic and organic components 37. In addition to serving as a scaffold for bone formation, dentin contains a collagen-rich matrix and various non-collagenous proteins, which have been implicated in osteogenic differentiation and bone remodeling 13. Consequently, autogenous dentin may exhibit both osteoconductive and osteoinductive properties, thereby promoting new bone formation and increasing mineralization around implants. Another factor that may have been a factor in the observed increase in bone density is the adjunctive utilize of PRF. The synergistic interaction between PRF and autogenous dentin particles may therefore explain the progressive increase in bone density observed throughout the follow-up period 38.

The present study demonstrated significantly reduced in marginal bone levels in the dentin graft group than the allograft group at both six and twelve months, indicating superior preservation of peri-implant crestal bone. Although both groups exhibited significant changes over time, the dentin group maintained more favorable peri-implant hard tissue dimensions throughout the follow-up period. The present results are consistent with previous reports showing that autogenous dentin grafts provide clinical and radiographic outcomes comparable to widely used xenografts, including Bio-Oss®, with similar marginal bone levels, implant stability, and survival rates 33. Autogenous mineralized dentin also showed no significant difference in clinical or radiographic outcomes versus xenografts in delayed implant sites 39. Reviews report low marginal bone levels, stable new bone, and high implant survival with autogenous tooth biomaterials, especially in socket preservation and GBR settings 40,41. Autogenous dentin grafts promoted mature, well-vascularized bone formation and good graft integration in clinical studies 42.

CONCLUSION

From the results of this research, it can be concluded that autogenous dentin graft demonstrated superior peri-implant soft tissue healing, enhanced bone maturation, and better preservation of marginal bone levels compared to allograft, suggesting that autogenous dentin graft may be considered a predictable and biologically favorable alternative for the management of peri-implant defects during immediate implant placement. In order to verify these findings and evaluate long-term clinical outcomes, additional research with larger sample sizes and extended follow-up intervals is advised.

REFERENCES

1. Ebenezer V, Balakrishnan R, Priya RS. Immediate placement of implant -A case report. *Biomed Pharmacol J.* 2015;8SE:437-440. doi:10.13005/bpj/718
2. Javaid MA, Khurshid Z, Zafar MS, Najeeb S. Immediate implants: Clinical guidelines for esthetic outcomes. *Dent J.* 2016;4(2). doi:10.3390/dj4020021
3. Krishna M, Basu P, Mohapatra A, Choudhury GK, Nanda K. Immediate implant placement in mandibular esthetic zone: A clinical report. *Indian J Forensic Med Toxicol.* 2020;14(4):8985-8989.

- doi:10.37506/ijfimt.v14i4.13138
4. Ataulloh K, Chee LF, Peng LL, Tho CY, Wei WC, Baig MR. Implant placement in extraction sockets: a short review of the literature and presentation of a series of three cases. *J Oral Implantol.* 2008;34(2):97-106. doi:10.1563/1548-1336(2008)34[97: IPIESA]2.0.CO;2
 5. AlKudmani H, Jasser RAL, Andreana S. Is bone graft or guided bone regeneration needed when placing immediate dental implants? A systematic review. *Implant Dent.* 2017;26(6):936-944. doi:10.1097/ID.0000000000000689
 6. Putters TF, Raghoobar GM, Klein-Nulend J, Vissink A, Schortinghuis J. Immediate dental implant placement in calvarial bone grafts to rehabilitate the severely resorbed edentulous maxilla: A prospective pilot study. *J Cranio-Maxillofacial Surg.* 2019;47(1):23-28. doi: 10.1016/j.jcms.2018.11.007
 7. Gunes N, Gul M, Dundar S, et al. Biomechanical Evaluation of Implant Osseointegration after Guided Bone Regeneration with Different Bone Grafts. *J Craniofac Surg.* 2021;32(4):1545-1548. doi:10.1097/SCS.00000000000007102
 8. Sakkas A, Wilde F, Heufelder M, Winter K, Schramm A. Autogenous bone grafts in oral implantology—is it still a “gold standard”? A consecutive review of 279 patients with 456 clinical procedures. *Int J Implant Dent.* 2017;3(1):23.
 9. Shibuya N, Jupiter DC. Bone graft substitute: allograft and xenograft. *Clin Podiatr Med Surg.* 2015;32(1):21-34.
 10. Grover V, Kapoor A, Malhotra R, Sachdeva S. Bone allografts: A review of safety and efficacy. *Indian J Dent Res.* 2011;22(3):532-537. doi:10.4103/0970-9290.87084
 11. Elmali OM, Eninanç I, Yeler DY, Hepokur C, Ünal Y, Yeler H. A STUDY ON THE USE OF DIFFERENT MATERIALS COMBINED WITH ALLOGRAFT ON OSSEOINTEGRATION AND BONE REGENERATION OF DENTAL IMPLANTS WITH CORONAL DEFECTS IN A RABBIT MODEL. *Cumhur Dent J.* 2020;23(3):232-239. doi:10.7126/cumudj.712055
 12. Khalifah MA, Elgendy AMA, Elgendy E. Untreated Mineralized Dentin Grafts (UMDGs) vs Xenografts Around Immediately Placed Dental Implants in the Mandibular Anterior Region: A Randomized Controlled Clinical Trial. *Int J Oral Maxillofac Implant.* 2024;39(3):381-388. doi:10.11607/jomi.10584
 13. Ravindran S, George A. Multifunctional ECM proteins in bone and teeth. *Exp Cell Res.* 2014;325(2):148-154.
 14. Andreucci CA, Fonseca EMM, Jorge RN. Immediate Autogenous Bone Transplantation Using a Novel Kinetic Bioactive Screw 3D Design as a Dental Implant. *BioMedInformatics.* 2023;3(2):299-305. doi:10.3390/biomedinformatics3020020
 15. Kanazirski N, Kanazirska P. Auto-Tooth Bone Graft Material for Reconstruction of Bone Defects in the Oral Region: Case Reports. *Folia Med (Plovdiv).* 2022;64(1):162-168. doi:10.3897/folmed.64. e59099
 16. Kızıldag A, Tasdemir U, Arabacı T, Kızıldag CA, Albayrak M, xSahin B. Effects of autogenous tooth bone graft and platelet-rich fibrin in peri-implant defects: An experimental study in an animal model. *J Oral Implantol.* 2020;46(3):221-226. doi:10.1563/aaid-joi-D-19-00038
 17. Alrmali A, Saleh MHA, Mazzocco J, Zimmer JM, Testori T, Wang H-L. Auto-dentin platelet-rich fibrin matrix is an alternative biomaterial for different augmentation procedures: A retrospective case series report. *Clin Exp Dent Res.* 2023;9(6):993-1004. doi:10.1002/cre2.808
 18. Soni M, Gugnani S, Pandit N, Bali D, Sharma M. Efficacy of leukocyte-platelet-rich fibrin membrane in immediate postextraction implant placement: A randomized controlled trial. *J Indian Soc Periodontol.* 2023;27(1):63-69. doi: 10.4103/jisp.jisp_219_21
 19. Mizar MA, Hassan KS, Mohammed AK, Mwafy IM. Platelet rich fibrin versus collagen membrane combined with beta tri calcium phosphate/collagen for treatment of dehiscence around immediately placed implants clinical and radiographic comparative study. *Al-Azhar Assiut Dent J.* 2021;4(2):189-196.
 20. Melek LN, El Said MM. Evaluation of “Autogenous Bioengineered Injectable PRF–Tooth graft” combination (ABIT) in reconstruction of maxillary alveolar ridge defects: CBCT volumetric analysis. *Saudi J Dent Res.* 2017;8(1-2):86-96.
 21. Dohan Ehrenfest DM, Del Corso M, Diss A, Mouhyi J, Charrier J. Three-dimensional architecture and cell composition of a Choukroun’s platelet-rich fibrin clot and membrane. *J Periodontol.* 2010;81(4):546-555.
 22. Kharalampos M, Put VA, Tarasenko S V, Reshetov I V. Comprehensive patient rehabilitation while performing immediate dental implant placement with the use of information-wave therapy (literature overview). *J Adv Pharm Educ Res.* 2020;10(2):11-14. <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85085918657&partnerID=40&md5=7cda0b0efbac6f33fd8849031ece4053>.
 23. Peñarrocha-Diago M, Aizcorbe-Vicente J, Ruz-Domnguez V, Soto-Peñaloza D, Peñarrocha-Oltra D. Immediate Loading in All-on-Four. In: *Atlas of Immediate Dental Implant Loading.* ; 2019:213–3239. doi:10.1007/978-3-030-05546-2_12
 24. Lung H, Wu AY-J, Huang H-L, Chee W. Two anterior wide-diameter implants using the All-on-4 concept in a predictable maxillary rehabilitation: A clinical report. *J Prosthet Dent.* 2016;116(4):483-487. doi: 10.1016/j.prosdent.2016.02.023
 25. Flanagan D. Autogenous Dentin with Calcium Sulfate as Graft Material: A Case Series. *J Oral Implantol.* 2022;48(4):285-294. doi:10.1563/aaid-joi-D-20-00309

26. Dkheel IA, Al-Quisi AF. The Effectiveness of Autogenous Dentin Graft as a Biomaterial in Optimizing the Esthetic Outcomes of Immediate Dental Implants: A Prospective Clinical Study. *Al-Rafidain J Med Sci.* 2023;5(1): S81-S86. doi:10.54133/ajms. v5i1S.307
27. Cervera-Maillo JM, Morales-Schwarz D, Morales-Melendez H, Mahesh L, Calvo-Guirado JL. Autologous Tooth Dentin Graft: A Retrospective Study in Humans. *Med.* 2022;58(1). doi:10.3390/medicina58010056
28. Iram J, Ajaz S, Hussain SS, Irshad A, Shahid H, Jahangir I. Immediate dental implant placement with and without Platelet-Rich Fibrin (PRF) in esthetic zone: A comparative study. *Natl J Maxillofac Surg.* 2024;15(3):467-473. doi: 10.4103/njms.njms_42_23
29. Elraee L, Abdel Gaber HK, Elsayed HH, Adel-Khattab D. Autogenous dentin block versus bone block for horizontal alveolar ridge augmentation and staged implant placement: A randomized controlled clinical trial including histologic assessment. *Clin Oral Implants Res.* 2022;33(7):723-734.
30. Ouyang L, Li J, Dong Y, et al. Comparison of clinical efficacy between autologous partially demineralized dentin matrix and deproteinized bovine bone mineral for bone augmentation in orthodontic patients with alveolar bone deficiency: A randomized controlled clinical trial. *BMC Oral Health.* 2024;24(1):984.
31. Hassan KS. Autogenous bone graft combined with polylactic polyglycolic acid polymer for treatment of dehiscence around immediate dental implants. *Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology.* 2009;108(5): e19-e25.
32. Kukreja BJ, Aseri AA, Vashisht A, et al. Effect of L-PRF and autogenous bone grafts for immediate implant placement in post tooth extract socket. *Bioinformation.* 2024;20(6):639.
33. Mahardawi B, Jiaranuchart S, Tompkins KA, Pimkhaokham A. Efficacy of the autogenous dentin graft for implant placement: a systematic review and meta-analysis of randomized controlled trials. *Int J Oral Maxillofac Surg.* 2023;52(5):604-612.
34. Braga YF, Maferano EFE, Lopes TS, Neto MR-N, Macas LEV, Costa FWG. Autogenous dentin grafts in implant dentistry: A scoping review of clinical applications and processing protocols. *Med Oral Patol Oral Cir Bucal.* 2025;31(2): e251.
35. Łobacz M, Wiczorek K, Mertowska P, et al. Evaluation of Peri-Implantitis Bone Defect Healing: Comparing the Efficacy of Small-Particle Dentin and Bio-Oss in Bone Density Attenuation. *J Clin Med.* 2024;13(16). doi:10.3390/jcm13164638
36. Quoc JB, Vang A, Evrard L. Peri-implant bone loss at implants placed in preserved alveolar bone versus implants placed in native bone: A retrospective radiographic study. *Open Dent J.* 2018;12(1):529-545. doi:10.2174/1874210601812010529
37. Minetti E, Palermo A, Malcangi G, et al. Dentin, dentin graft, and bone graft: microscopic and spectroscopic analysis. *J Funct Biomater.* 2023;14(5):272.
38. Yüceer-Çetiner E, Özkan N, Önger ME. Effect of Autogenous Dentin Graft on New Bone Formation. *J Craniofac Surg.* 2021;32(4):1354-1360. doi:10.1097/SCS.00000000000007403
39. Santos A, Botelho JT, Machado VS, Mascarenhas P, Alcoforado GAP. Autogenous Mineralized Dentin versus Xenograft granules in Ridge Preservation for Delayed Implantation in Post-extraction Sites: A Randomized controlled clinical trial with an 18 months follow-up. *Clin Oral Implants Res.* 2021;32(8):905-915. doi:10.1111/clr.13765
40. Mahardawi B, Rochanavibhata S, Jiaranuchart S, Mattheos N, Pimkhaokham A. Autogenous tooth bone graft material prepared chairside and its clinical applications: a systematic review. *Int J Oral Maxillofac Surg.* 2023;52(1):132-141. doi: 10.1016/j.ijom.2022.04.018
41. Picone A, Castro FC De, Falcao A, Fernandes JCH, Fernandes GVDO. Autogenous Tooth Graft Biomaterial in Guided Bone Regeneration: A Comprehensive Review. *Surgeries (Switzerland).* 2024;5(4):929-947. doi:10.3390/surgeries5040075
42. Abo-El-Saad MM, Melek LN, Abdel Fattah HS, Ayad SS. Autogenous dentin graft versus alloplastic graft combined with socket shield for pre-implant socket preservation: a split-mouth randomized clinical trial. *Int J Oral Maxillofac Surg.* 2023;52(10):1090-1096. doi: 10.1016/j.ijom.2023.01.010