BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 4

DOI: 10.58240/1829006X-2025.21.4-5

RESEARCH ARTICLE

A STUDY TO EVALUATE THE BONE AUGMENTATION WITH LEUKOCYTE AND PLATELET RICH FIBRIN PREPARATION IN EXTRACTION PLACEMENTS AND ITS INFLUENCE ON PERI IMPLANT TISSUE

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Received: *Apr 5, 2025;* ***Accepted:*** *Apr. 30, 2025;* ***Published:*** *May. 15,2025*

ABSTRACT

Purpose: A study was done to evaluate bone augmentation and its influence on peri-implant tissue in implant-supported prosthesis in extraction and immediate placement scenarios.

Material and methods: A total of 20 patients underwent atraumatic extraction with immediate endosteal implant placement and immediate provisional loading. The patients were categorized as Group I: 10 patients indicated for atraumatic extraction and immediate endosteal implant placement and immediate provisional loading and Group II: 10 patients were indicated for atraumatic extraction with socket augmentation and immediate provisional loading. Volumetric changes of the sites were recorded at 3 months and 6 months post-operative with a D-SLR camera NIKON D 3100 with a Macro lens (1:1).

Results: Statistical analysis showed a significant increase in the papilla in the augmented site than non-augmented site. Soft tissue healing however was similar.

Conclusion: Within the limitations of the study, it can be safely concluded that soft tissue healing is better with provisionalisation even without socket grafting in the anterior esthetic zone. Nevertheless, there are long-term benefits of socket grafting.

Keywords: Immediate provisionalisation, Peri-implant esthetics, Socket augmentation

1. INTRODUCTION

Implant treatment has evolved a lot over the years. Two-stage and one-stage implant placement are very common among the population and they are not as case sensitive as the immediate implants. Even though Immediate implants clearly reduce patient visits and interventions, there are various factors influencing the success of the treatment. Hard and soft tissue architecture, implant stability, three-dimensional positioning, socket augmentation, and provisionalisation, to name a few.[1] Immediate implant in extraction sockets with immediate provisionalisation has its own challenges. The “aesthetic zone,” that is the anterior teeth has high visibility and patients are highly sensitive to the appearance. The papilla plays a major role which in turn is determined by the interproximal architecture of bone of the adjacent teeth, the facial mucosa contour, the root proximity the phenotype of the soft tissue, the reason for the loss of teeth, buccal bone fenestrations.[2] In addition to saving time, the reason for still opting for immediate placement and provisionalisation is to potentially maximize the preservation of hard and soft

tissues. A well-done provisional restoration for immediate extraction cases can not only regain theconfidence of patients but also provide a blueprint for the tissues to restore themselves to their original midfacial, gingival, and interdental papillary architecture.[3]

Tarnow et al., 30 years back stated that the distance from the contact point of the teeth to the crestal bone level should be five mm or less to ensure complete interdental papillary fill.[4] When there is loss of hard tissue around the peri-implant marginal bone area, per implant mucosa can also be affected or compromised by a break in seal and thus, affect the health.[5] This could inevitably cause aesthetic failures. It is a known fact that the level of interdental papilla relies also on the bone next to the adjacent teeth. In cases with buccal bone fenestration or dehiscence, immediate extraction warrants bone augmentation.[6] To date no study has compared papilla volume of immediately placed implants and loading without bone augmentation and immediate placement of implants with loading along with bone augmentation. The study aimed to compare the volume of interproximal papilla and thereby the zenith of immediate loading of implants in fresh extraction sites before and after bone augmentation on the day of loading and at the time interval of 3 months and 6 months.

2. MATERIAL AND METHODS

Twenty patients with unrestorable teeth were selected from the outpatients at the Department of Prosthodontics and Crown and Bridge at AB Shetty Memorial Institute of Dental Sciences, Mangalore India. Patients were deemed unsuitable for this study if they presented with one or more of the following: poor oral hygiene, smoking more than 10 cigarettes per day, uncontrolled diabetes, immune diseases, and head and neck radiation in the preceding 12 months. Localized dehiscence or fenestration, and signs of acute periodontal infection at the surgical site were also excluded from the study. The study was approved by the Institutional Ethics Committee at AB Shetty Memorial Institute of Dental Sciences (ABSM/EC/306/2023).

2.1 Presurgical preparation

Informed consent was taken after explaining the benefits and the risks associated with the procedure. Post-operative care also was strictly enforced. A papillary bleeding index (Muhlemann H.R. 1977)[8] was recorded to record the health of the gingival tissues. A preoperative X-ray was taken to evaluate the bone architecture, thereafter selection of the implants was done. Diagnostic models and wax mock-ups were done for provisionalisation.

Liquid Platelet Concentrate Preparation: 10cc of blood was collected to obtain the liquid platelet concentrate preparation Leukocyte and Platelet Rich Fibrin(L-PRF). The centrifuge (Duo Quattro) was equipped with preprogrammed operational panel for the centrifugation of blood. Thus,

L-PRF (2300 rpm for 12mins) was obtained as per manufacturers recommendations.This was then used within 30 minutes of preparation along with the alloplastic graft for the augmentation group.

2.2 Surgical phase

Patients were prescribed prophylactic antibiotic therapy (Amoxicillin 500 mg) The implant surgery was performed by a single operator. All implants were categorized into two groups. The most common implants were Sandblasted Acid-etched implants. Grade 2 and Grade 5 Ti was used for the study. Ankylos implants (Dentsply, Mannheim, Germany); and Straumann implants with SLA surface (Straumann, Basal, Switzerland), including bone level or tissue level implants were the predominant implant systems used.

Group I (Control Group N=10) included 10 patients who received no bone augmentation after the immediate placement.

Group II (intervention group n=10) included 10 patients who received bone augmentation with alloplastic material (sybograf-plus) with a composition of 70% nanocrystalline hydroxyapatite and 30% beta-tricalcium phosphate and LPRF.

In a sterile operatory, the implant surgery began with the disinfection of the facial skin with Povidone – (Iodine Solution IP (Betadine) paint). Induction of local anaesthesia was carried out using Lignospan special (2% lidocaine with 1:80,000 Adrenaline). The procedure commenced with the atraumatic extraction of the teeth requiring replacement with the help of sharp periotomes. Osteotomy was done on the thick palatal wall of the extraction socket for reasons such as prevention of labial perforation along with bypassing buccal resorptive patterns of the maxilla.[7] Immediate implant placement was performed. Surgical sites were prepared to achieve stability of at least 35 Ncm which was a prerequisite for immediate loading and provisionalisation. As per the implant abutment torque standards the abutment was torqued, 15 Ncm in this case Group II: the standard protocol mentioned above for osteotomy was maintained. Subsequently following implant placement, bone graft (alloplast+LPRF) was condensed in the implant-socket gap (>2mm jumping distance).

The abutment was torqued and the provisionals of the tissue surface is well contoured into the material.

2.3 Prosthetic phase

Provisional restoration was done using light cure resin-based composite material (Protemp 4, 3M ESPE). The provisional was kept out of occlusion for the transitional phase of three months. A metal-ceramic implant-supported crown was fabricated and fixed onto the implant with the final torque established by the manufacturers (25Ncm) at 3 months post-operative. Photographs were taken with D-SLR camera Nikon D 3100 and macro lens along with a set magnification of 1:1 by the same operator. Soft tissue profile photographs were taken pre and post-implant placement, provisional loading phase, and also during 3 months and 6 months post crown fixation.

The papillary fill was measured by drawing an imaginary line joining the most apical part or the zeniths of the adjacent teeth. A perpendicular line was then drawn to connect the contact point in the software Adobe Photoshop version 10. The line was equally divided into parts. The papillary volume fill was measured using the papilla index (JEMT 1997)[9] (figure 1). The papillary fill was measured by joining the zeniths of the adjacent teeth and then drawing a line perpendicular to it till the contact point in the software Adobe Photoshop version 8. The data obtained i.e. the papilla level changes on the mesial and distal side of the implant was tabulated in Microsoft Excel Sheets and the statistical analysis was performed using SPSS 15 software.

2.4 Statistical analysis

Statistical analysis was performed using IBM SPSS version 23. Comparisons of gingival fill at various time intervals were done using the Friedman test.

3. RESULTS

3.1 Comparison of gingival fill between the control group and Augmented Group

The Mean of the control and augmented group at baseline on the mesial side was 10.50. Mean of the distal side of the control and the augmented group was 10.50. The mean of 3 months distal and mesial of control was 11.30 mean of 3 months distal and mesial of augmented group was 9.70. The mean of the mesial side at 6 months of the control group was 11.65 and the augmented side was 9.35. and the mean of the distal side of the control group was 11.75 and the augmented side was 9.25. There was no statistically significant difference in the gingival fill between the control group and the bone graft group on both mesial and distal sides.

Table 1. Comparison of gingival fill between the control group and Augmented Group

Ranks						
	Group	**N**	**Mean Rank**	**Sum of Ranks**	**Mann-Whitney**	**P value**
Mesial_ Baseline	Control	10	10.50	105.00	50.000	1.000
	AUGMENTED GROUP	10	10.50	105.00		
	Total	20				
Distal_ Baseline	Control	10	10.50	105.00	50.000	1.000
	AUGMENTED GROUP	10	10.50	105.00		
	Total	20				
Mesial_3 months	Control	10	11.30	113.00	42.000	.473
	AUGMENTED GROUP	10	9.70	97.00		
	Total	20				
Distal_3 months	Control	10	11.30	113.00	42.000	.473
	AUGMENTED GROUP	10	9.70	97.00		
	Total	20				
Mesial_6 months	Control	10	11.65	116.50	38.500	.350
	AUGMENTED GROUP	10	9.35	93.50		
	Total	20				
Distal_6 months	Control	10	11.75	117.50	37.500	.304
	AUGMENTED GROUP	10	9.25	92.50		
	Total	20				

Table 2. Comparison of gingival fill in the control group at different time intervals -Friedman Test

Side	Sample1–Sample2	Test statistic	Std error	Std test statistic	significance	Adjusted significance/p-value
Mesial_control	Baseline–3months	**-9.700**	**4.851**	**-2.117**	**0.034**	**0.205**
	Baseline–6months	**-18.700**	**4.851**	**-4.082**	**0.000**	**0.000**
	3months–6months	**-9.000**	**4.851**	**-1.965**	**0.049**	**0.297**
Distal_control	Baseline–3months	-10.800	4.640	-2.328	0.020	0.120
	Baseline–6months	-22.900	4.640	-4.936	0.000	0.000
	3months–6months	-12.100	4.640	-2.608	0.009	0.055
Mesial_augmented	Sample1–Sample2	**Test statistic**	**Std error**	**Std test statistic**	**significance**	**Adjusted significance/p-value**
	Basleine-3months	-3.850	5.015	-0.768	0.443	1.00
	Baseline -6months	-8.800	5.015	-1.755	0.079	0.476
Distal_augmented	Sample 1–Sample2	**Test statistic**	**Std error**	**Std test statistic**	**significance**	**Adjusted significance/p-value**
	Baseline–3months	-4.200	5.027	-0.836	0.443	1.00
	Baseline–6months	-10.250	5.027	-2.039	0.041	0.249

Control group: The mean at different intervals at the mesial side in the control group was 1.30, 2.40, and 3.40 respectively at baseline 3 months and 6 months. There was a statistically significant difference in gingival fill on the mesial side of the control group. The difference in gingival fill between baseline and 6 months was statistically significant. In the control group, On the distal side, the mean was 1.25, 2.35, and 3.55 at baseline, 3 months, and 6 months respectively. There was a statistically significant difference in gingival fill on the distal side of the control group. The difference in gingival fill between baseline and 6 months was statistically significant.

Augmented group: The mean of the mesial side of the augmented group was 1.55, 2.05, and 2.70 at baseline, 3 months, and 6 months. There was a statistically significant difference in gingival fill on the mesial side of the augmented group. The difference in gingival fill was not statistically significant. The means of the distal side were 1.60, 2.05, and 2.70 at baseline, 3 months, and 6 months respectively. The difference in gingival fill between not statistically significant.

4. DISCUSSION

The maxillary anterior region is by far one of the hardest regions to rehabilitate. Not just the obvious reason of aesthetics and speech but also the bony architecture is way too compromised and unpredictable. The most common cause of tooth loss in the anterior region is trauma and tooth decay. So immediate extraction and placement could be a viable choice. Chen et al in their study has emphasized the hard tissue and soft benefits of extraction and immediate placement such as faster healing time.[10] Lang et al. in their systematic review concluded that that extraction and immediate placement have successful and predictable outcomes. Initial loss of bone in the first should be overcompensated with sub crestal placement.[11] Although promising aesthetic and functional results are documented in extraction placement by many authors, soft tissue healing is always compromised after an extraction placement, due to lack of periodontal recovery and inevitable bone loss.[12,13] To compensate grafting the jumping distance and provisionalising on the same day can also form a foundation for good soft tissue architecture.[14] The present study was intended to evaluate the volume of the papillary fill and gingival zenith and compare it with non-augmented sites.

The gingival was periodically evaluated at three months and six months follow-up. The present study evaluated the effect of bone augmentation on the soft peri-implant tissues. The bone graft used in the study is an alloplastic material (sybograf-plus) with a composition of 70% nanocrystalline hydroxyapatite and 30% beta tricalcium phosphate along with autologous blood formulation LPRF i.e. Leukocyte and platelet-rich fibrin. The presence of hydroxyapatite crystals and beta tricalcium phosphate with sizes varying from 300-500 microns helps in faster bone formation and also acts as a scaffold for the generation of new bone thus providing mechanical stability to the overlying soft

tissues.[14-20] LPRF has known to have faster wound healing properties. Thus, a composite graft should ideally provide faster healing.[20-23]

Even though there are benefits of augmentation, these procedures can be tedious and financially challenging, thus for jumping distances of less than 2mm we can still just provide provisionals that would manipulate the papilla and also in the grafted site mechanically stabilise the graft. Making sure the provisional is out of occlusion a constant follow-up is necessary to check on the intaglio surface of the provisional and modifications can be done as and when required. A screw-retained prosthesis would be an ideal option.[24–26] In this study there was a mean increase in the volume of interdental papilla and complete papillary fill in both control (group I) and augmented group (group II) at 3 months and 6-month follow-up. Nevertheless, the mean increase in the augmented site was more both in the distal as well as the mesial side comparable to the result of various studies.[10,14,25-27] In a study done by Rojas et al.,[28] he concluded that the success rate is slightly greater in the case of immediately placed implants. Immediate placement and loading with a provisional in the anterior region of the maxilla may be considered a promising treatment outcome based on the present short-term study of 6 months in function with a 95% survival rate.

The study had no long term follow up of the soft tissue profile. The index used also does not give any elaboration on the nature, consistency and the area-wise volume of the periodontium. Since the interpretation of photographs are very subjective, there is a reason to believe more sensitive tests are required to fulfil the accuracy.

5. CONCLUSION

Within the limitation of the study, the following conclusion has been drawn: LPRF and alloplastic grafting material can be considered a viable option for developing bone in extraction sockets. Provisionalisation added to the bone growth and soft tissue contouring. A well-placed implant and socket grafting can deliver esthetic results in the anterior zone.

DECLARATIONS

Ethical approval and consent to participate – The study was approved by the Institutional Ethics Committee at AB Shetty Memorial Institute of Dental Sciences (ABSM/EC/306/2023) and consent was taken from all participants before data collection.

Availability of data and material

All data generated or analyzed during this study are included in the published article.

Competing interest

The authors declare that there are no competing interest.

Acknowledgements

None

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