Original Article

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Dentistry Section

Effect of Platelet Rich Fibrin (PRF) on Peri-implant Soft Tissue and Crestal Bone in One-Stage Implant Placement: A Randomized Controlled Trial

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ABSTRACT

Introduction: The viability of Platelet Rich Fibrin (PRF) on enhancement of osseous and associated tissue healing has been substantiated well in literature. However, paucity in the applicability of PRF to enhance peri-implant healing in oral region is not well-corroborated.

Purpose: This prospective study evaluated the effect of Platelet PRF on peri-implant tissue response following one-stage implant placement with non-functional immediate provisionalization in maxillary anterior region.

Materials and Methods: A Prospective, Randomized Controlled Trial (RCT) was conducted across 20 (15 male, 5 Female) systemically healthy subjects with maintainable oral hygiene. Subjects were broadly divided into two groups i.e. Study group (PRF group) and Control group (Non-PRF group). Twenty standard SLA- AB/AE (alumina oxide blasted/acid etched surface treated) tapered threaded dental implants were randomly placed with and without PRF and immediately provisionalized. The subjects were evaluated clinically and radiographically at baseline (at time of implant placement), one month and three month post-operatively for peri-implant soft tissue and crestal bone responses.

Results: At 3 months, all implants remained osseointegrated. The mean marginal bone changes were observed from baseline to 3 months in both groups with lesser changes observed in PRF Group. No significant differences in probing depth and bleeding on probing were noted during follow-up.

Conclusion: Within the limitations of this study, PRF could be considered as a healing biomaterial with potential beneficial effect on peri-implant tissue and can be used as a therapeutic adjuvant in clinical scenario of one stage, single tooth implant placement procedure in maxillary anterior region.

Keywords: Dental Implants, Fibrin membrane, Immediate loading

INTRODUCTION

The loss of single tooth in the aesthetic zone is most distressing experience. Single tooth implant placement has revolutionized the treatment options with marked documented success rate. The conventional guidelines have suggested the bone remodeling period of 2-3 months following tooth extraction followed by an additional 6 months load free implant osseointegration. The additional requirement for a removable prosthesis during this extended healing phase appeared inconvenient and results in reduce comfort, acceptance and final outcome of treatment [1,2].

Recent preliminary studies reported high success rate following one-stage, immediate provisionalized endosseous implant placement in maxillary anterior region. Besides eliminating the need of interim removable denture, this technique has documented the potential for preserving the osseous and gingival architecture. The highly aesthetic zone of maxilla often requires both hard and soft tissue architecture maintenance and hence, maxillary anterior single tooth placement is often a challenge, regardless of experience of clinician [3,4]. Although the propensity of peri-implant tissue to recession after surgical trauma has been well recognized. However, the response of peri-implant tissue loaded with PRF following implant placement is not well documented.

Various studies have substantiated the viability of platelet concentrates on enhancement of osseous and associated tissue healing [4-7] and PRF is one of the recent innovations of various platelet concentrates. PRF is an immune and platelet concentrate collecting on a single fibrin membrane and contains all the constituents of blood favorable to healing and immunity. One of the most desirable features of PRF is its efficacy in providing concentrated growth factors at the surgical site to stimulate the healing process. PRF is considered as a healing biomaterial and it has a robust stimulating effect on various aspects of healing of soft and osseous tissue including angiogenesis, immune control, harnessing the circulating stem cells [8-10]. PRF efficacy in optimizing and preserving the existing osseous structure and gingival architecture across peri-implant need to be corroborated.

Hence, a Prospective, Randomized Controlled Trial (RCT) was conducted to evaluate the effect of Platelet Rich Fibrin (PRF) on peri-implant tissue response across one-stage, non-functional immediate provisionalized implant in maxillary aesthetic zone.

MATERIALS AND METHODS

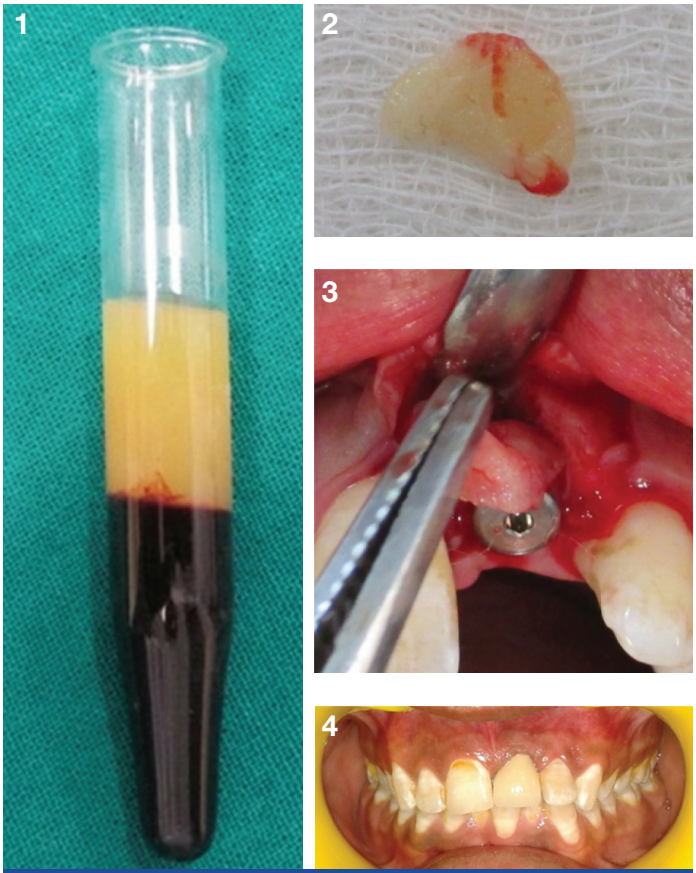
A Prospective Randomized Controlled Trial (RCT) was conducted at Post Graduate Institute of Dental Sciences, Rohtak, Haryana, India, on 20 (15 male, 5 female) subjects with a mean age of 24.6 (range 18-33 y) from February 2013 to November 2014. The inclusion criteria were subjects with i) maintainable oral hygiene, ii) partially edentulous state in relation to anterior maxilla, iii) adequate bone quantity at the implant site. Exclusion Criteria were subjects i) having infection around implant site, ii) history of bleeding disorder or on anticoagulant therapy, iii) immunocompromised state and debilitating disease. The study was approved by Institutional Ethical Committee with a trial number PGIDS/IEC/2014/124. All selected subjects who consented to participate, received a standard treatment with single implant system (Adin Dental Implant System, Israel). Randomization of the subjects (10 in each group) was done through lottery system and were categorized as: Group I (Test group)-PRF group and Group II (Control group) - Non PRF group.

PRF preparation and placement: The PRF was prepared fresh just before placement at the surgical site. For the PRF preparation10 ml

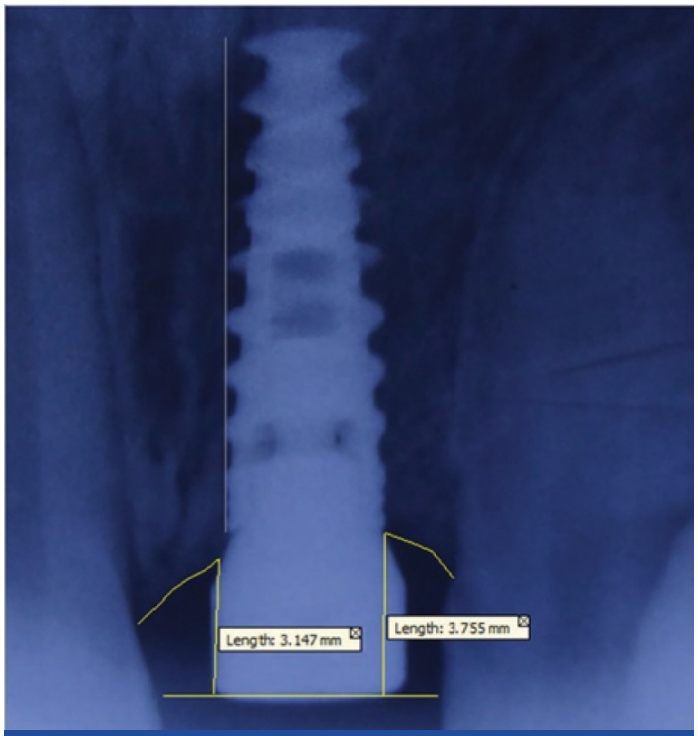
of blood was drawn from the antecubital vein and transferred to the test-tube without anticoagulant. The blood sample was immediately centrifuged at 3000 rpm for 10-12 min. After centrifugation fibrin clot was squeezed between gauze-piece to obtain PRF membrane [Table/Fig-1,2].

The surgical phase involved full thickness mucoperiosteal flap reflection with osteotomy site preparation through sequential drilling for both the groups. The implant was positioned in the osteotomy site flushing it with the margin of the crest. Abutment was placed with 30 N-cm of torque following the one-stage non-functional immediate prosthetic protocol. The immediately prepared PRF was placed over the surgical site and flap was sutured [Table/Fig-3]. After 10-14 d, provisionalization was accomplished with prefabricated polycarbonate crowns cemented with temporary zinc oxide non-eugenol (Relyx Temp NE, 3M ESPE) cement. Instructions regarding hygiene maintenance and soft diet plan were provided. After 4 months of implant placement, cementation of definitive prosthesis was done with zinc phosphate cement (Super Cement SHOFU) [Table/Fig-4].

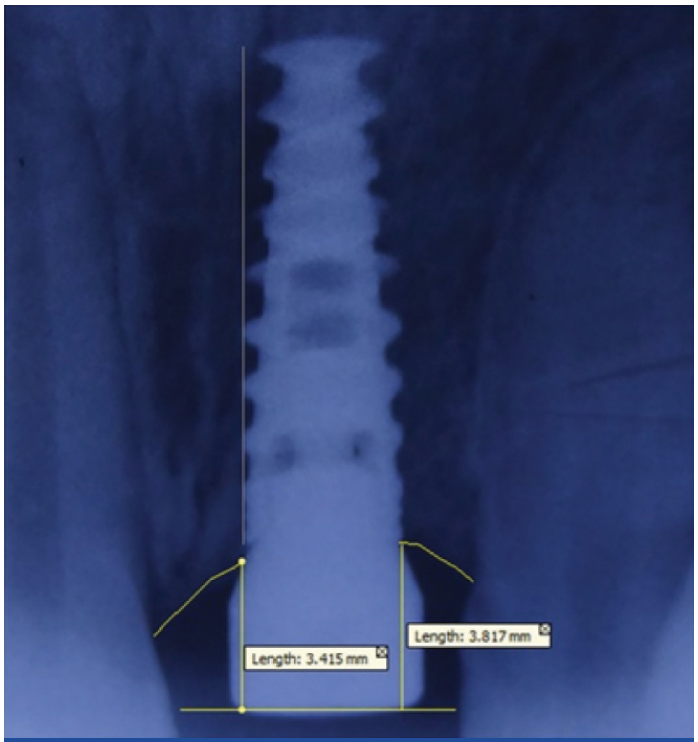
Clinical and radiographic assessment: The measurements for crestal bone changes were made at baseline (at time of implant placement), one month and three month after implant placement. The Intra oral periapical radiographs obtained by using a paralleling technique were digitized for measurement of bone level on mesial and distal surfaces of implant [Table/Fig-5,6]. The measurements were made with the help of UTHSCSA Image Tool (version 3.00 for Windows, University of Texas Health Sciences Centre in San Antonio, TX). The most coronal point of healing abutment was taken as a static reference line. The point of bone to implant contact was chosen as the bone level. Measurements were made at the mesial and distal aspect of implants by placing perpendicular line from the static reference line to the bone level. The assessment of soft tissue changes were evaluated at one month and three month after implant placement using William's periodontal probe graded in mm (North Carolina–Hu-Friedy, Chicago, IL, USA).



[Table/Fig-1]: PRF obtained after centrifugation; **[Table/Fig-2]:** PRF membrane; **[Table/Fig-3]:** PRF membrane placed at the surgical site; **[Table/Fig-4]:** Final prosthesis in situ



[Table/Fig-5]: Digitized IOPA for measurement of crestal bone at 1 month



[Table/Fig-6]: Digitized IOPA for measurement of crestal bone at 3 month

1. The Probing Pocket Depths (PPD) was measured in mm.
2. Bleeding on probing (BOP) measured 15 s after probing and recorded as presence or absence.

STATISTICAL ANALYSIS

The mean, standard deviation, standard error of mean, were calculated and subjected to statistical analysis by Student t-test (paired) and Independent t-test for quantitative data and chi-square test for qualitative data on SPSS version 17.0.

RESULTS

Crestal bone level changes were observed both in study and control group. In PRF Group statistically significant crestal bone level changes were noted within three months, with a mean change

Time of Measurments	Bone Loss Side	Group (n=10)	Mean± Standard Deviation	Standard error of mean	p-value
Baseline-1month	Mesial	I	0.13±0.04	0.01	0.007
		II	0.3±0.16	0.05	
	Distal	I	0.15±0.04	0.01	0.02
		II	0.3±0.18	0.05	
Baseline-3 months	Mesial	I	0.25±0.06	0.01	0.0004
		II	0.57±0.22	0.07	
	Distal	I	0.27±0.07	0.02	0.0006
		II	0.65±0.28	0.08	
1 month-3 Months	Mesial	I	0.11±0.04	0.01	0.0005
		II	0.26±0.16	0.05	
	Distal	I	0.11±0.05	0.01	0.0004
		II	0.34±0.26	0.08	

[Table/Fig-7]: Comparison of crestal bone level changes between Group I and Group II on mesial and distal side at different time interval

Time of Measurements	Probing side	Group (n=10)	Mean± Standard Deviation	Standard error of mean	p-value
1 Month	Mesial	I	5±0.8164	0.2	>0.05
		II	5.3±0.6749	0.2	
	Distal	I	5.1±0.7378	0.2	>0.05
		II	5.1±0.8755	0.2	
3 Months	Mesial	I	3.05±1.11	0.3	>0.05
		II	3.1±0.3162	0.1	
	Distal	I	3.65±0.8181	0.2	>0.05
		II	3.8±0.7888	0.2	

[Table/Fig-8]: Comparison of probing depth between Group I and Group II on mesial and distal side of dental implants at different time interval

Time of Measurement	Group (n=10)	Subjects with positive finding (n=10)	Percentage (%)	p-value
1 month	I	5	50	χ^2 = 0.00; df=1; p=1 (>0.05) N.S.
	II	5	50	
3 months	I	2	20	χ^2 = 0.266; df=1; p=0.605 (>0.05) N.S.
	II	3	30	

[Table/Fig-9]: Comparison of bleeding on probing between Group I and Group II on mesial and distal side of dental implants at different time interval

of 0.25±0.06 mm mesially and 0.27±0.07 mm distally. 'Within Non PRF Group Statistically significant crestal bone level changes were noted within three months, with a mean change of 0.57±0.22 mm mesially and 0.65±0.28 distally. However, the amount of crestal bone level changes as exhibited in study group had statistically significant lesser mean value than control group [Table/Fig-7].

At 3 months, a mean decrease in probing depth was observed on mesial and distal side of dental implant in both PRF group and Non PRF group. [Table/Fig-8] Intergroup comparison for probing depth and bleeding and probing at one month and three months was statistically insignificant. [Table/Fig-8,9].

DISCUSSION

The peri-implant bone quantity and quality not only affects osseo-integration phase, but also influences the overlying soft tissues architecture. Assessment of marginal bone levels and peri-implant soft tissues has become an integral part of the evaluation of the implant patient and is usually a significant indicator of implant health. For successful implant therapy, preservation of peri-implant bone is one of the most important factor and in the process of tissue repair and regeneration the quality and quantity of peri-implant bone and soft tissue can be improved and by harnessing the regenerative capacity of surrounding tissue with the appropriate stimuli. Various growth factors are expressed during different phases of tissue healing and hence could serve as therapeutic agents to enhance both peri-implant soft and hard tissue repair. Platelet concentrates is one of these various growth factors and PRF is one of the recent innovation of various platelet concentrates [5,6].

Platelet Rich Fibrin (PRF) is a concentrated suspension of growth factors found in platelets. These concentrates contains high levels of growth factors including PDGF (platelet derived growth factors), transforming growth factors β1 and β2 (TGF β1, β2),vascular endothelial growth factors (VEGF), platelet derived endothelial growth factors, Interleukin 1&2, basic fibroblast growth factor (β-FGF), platelet activating factor 4 (PAF-4) [11]. The cascade of reaction involves immediate binding of secreted growth factors to the transmembrane receptors present on the external surface of cell membranes in graft, flap or wound. This result in activation of an endogenous internal signal protein, which further initiate the expression of a normal gene sequence of cell such as matrix formation, cellular proliferation, osteoid production, and collagen synthesis [5,6,9]. Synergistic role of these platelets derived factors in bone and soft tissue healing has been reported in literature [12,13].

Various studies have been conducted on PRF and its clinical application in various disciplines of dentistry. PRF is used for continuity defects, sinus lift augmentation, horizontal and vertical ridge augmentations, ridge preservation grafting, periodontal defects, cyst enucleation, healing of extraction wounds, endodontic surgeries and to treat gingival recession [7-12,14]. All these studies showed that PRF is a healing biomaterial for both soft and hard tissue because of the presence of various growth factors. To the best of our knowledge, there is no study that has showed the effect of PRF on periimplant hard and soft tissue changes. PRF has been studied mainly for the purpose of bone augmentation and soft tissue healing at other sites. However PRF potential to optimize periimplant soft and hard tissue healing has not been investigated specifically. Hence, this study was conducted to evaluate the effect of PRF on periimplant tissues in the cervical region.

In this study the low mean marginal bone loss observed in PRF group may be result of the fact that PRF expressed many growth factors that promote and enhances both soft and hard tissue repair [8,11-13].

The cumulative dental implant success rate for the one-stage implant placement and immediate provisionalization procedure in this study was 100% (20/20) after three months with further follow up period of eight months. Previous studies showed a comparable rate of success when implant placed in the aesthetic zone following either the delayed loading approach (97%) or the immediate provisionalization approach (98%) [4]. There is evidence in favour of a rough surface in achieving greater magnitude and high rate of osseointegration [1]. Furthermore, threaded implants have shown to provide strongest immediate mechanical retention after placement [15,16]. In this study standard SLA-AB/AE (alumina oxide blasted/acid etched surface) treated threaded implants were used.

In addition to a natural looking restoration, single anterior implants aesthetics is also governed by the presence of harmonious gingival architecture. Bleeding on probing is a common occurrence and approximately 50% of both test group and control group showed positive findings at one months. However, at three months both test and control group showed only 20% and 30% of positive findings respectively, while reduction in tissue changes with respect to probing depth was observed in both groups at 3 months. In this study, though the tissue changes were observed at three months in both groups and statistically insignificant changes (p>0.05) were noted in the overall mean of both the groups. The reduction in tissue changes observed within three month indicated achievement of tissue stability around implant. The results of this study support the efficacy of this procedure in maintaining the gingival architecture in accordance with similar studies [14,17,18].

In this study intra-oral periapical radiographs used for the assessment of bone level were obtained by using paralleling technique to minimize distortion and standardized by using occlusal putty jig. CT scan was carried out for all the cases by placing radiographic stent fabricated by using milling machine by drilling a hole in the direction of desired location for implant placement and then this hole was filled with radio-opaque marker (gutta percha cone) and hence accurate assessment of the bone dimensions could be calculated at the exact predetermined site of implant location. A single implant system was used throughout the study. The PRF was freshly prepared and used without delay to exert maximum beneficial effect and glass tube was used to prepare PRF, as silica behaves as clot activator and necessary to start the polymerization process. The same centrifuge machine (Laboratory centrifuge model R-8C, Remi, India) was used throughout the study for the preparation of PRF and hence G force or g was maintained throughout the study. This study showed results of high clinical applicability in that it provides information on the effectiveness of PRF on the rehabilitation of anterior maxillary aesthetic zone. However, a longer follow-up would substantiate the study further.

CONCLUSION

Based on the results obtained from this study, a synergistic effect and clinical effectiveness of PRF on bone formation around dental implant for single staged implant with immediate provisionalization in maxillary anterior region has been noted. Hence, the available data demonstrated that the local application of PRF during implant placement has a strong stimulating effect on bone formation.

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