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# A COMPARATIVE EVALUATION OF IMMEDIATE IMPLANT PLACEMENT IN FRESH EXTRACTION SOCKET WITH AND WITHOUT THE USE OF PLATELET-RICH FIBRIN

Dentistry

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## ABSTRACT

**Background:** The goal of modern dentistry is to prevent tooth loss and provide a healthy dentition with optimal functional efficiency, structural balance, and esthetic harmony. With the increasing success rates of dental implants, clinicians and researchers have turned their approach toward making the duration of treatment shorter and more comfortable for the patient.

**Materials And Methods:** A total of 20 sites were selected and randomly divided into two groups. Of these, 10 immediate implants were placed with platelet-rich fibrin (PRF), while the other 10 immediate implants were placed without any similar adjunct. The patients were prospectively evaluated clinically and radio- graphically using cone beam computed tomography.

**Results:** It was observed that the patients in test group are favored with rapid soft tissue regeneration, diminished vertical bone loss, and improve with early wound closure, which helps in achieving an esthetic outcome and better patient acceptance. It can be used to fill horizontal defect distance or jumping distance for complete resolution of the space.

**Conclusion:** Immediate implants with PRF lead to stimulation and acceleration of bone regeneration and show tendency toward rapid soft tissue regeneration and reduced peri-implant pain and inflammation. Overall, it is recommended to use PRF as a viable option in improving success and reducing the treatment duration in immediate implants.

## KEYWORDS

Atraumatic extraction, Immediate implants, Platelet- rich fibrin.

## INTRODUCTION

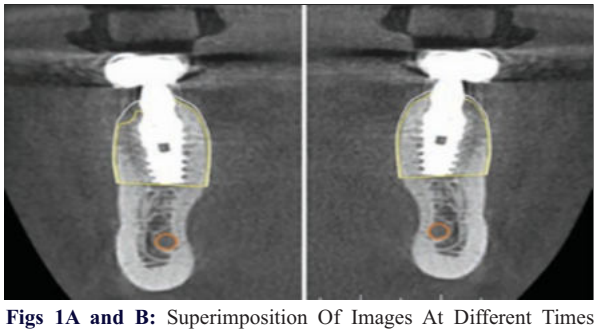
The goal of modern dentistry is to prevent tooth loss and provide a healthy dentition with optimal functional efficiency, structural balance, and esthetic harmony. With the ever-increasing success rates of dental implants, clinicians have turned their approach toward making the duration of treatment shorter and more comfortable for the patient. The demand for immediate implant placement is driven by a desire to retain alveolar volume for the patient. The placement of dental implant into fresh extraction sockets was introduced in 1970 and is a well-established treatment option for replacing missing teeth, allowing the restoration of masticatory function, speech, and esthetics Schwartz et al.[1] In addi- tion, with immediate implant placement, there is minimal use of surgical drills because the socket is already found except for a slight increase of the socket length in an attempt to improve primary stability. The decreased surgical trauma will decrease the risk of bone necrosis and permit bone remodeling process to occur, i.e., the healing period is rapid and allows the woven bone to be transformed into lamellar bone. However, in immediate implant placement, there is a gap present between the implant surface and socket wall, and there are various materials used to fill this gap (jumping distance) for better osseointegration, such as autografts, allografts, xenografts, and alloplasts. However, these materials are either expensive or not so effective. Platelet-rich fibrin (PRF) was first developed in France by Choukroun et al.[2] This second-generation platelet concentrate eliminates the risk associated with the use of bovine thrombin and is widely used to accelerate soft and hard tissue healing. It is a matrix of autologous fibrin in which are embedded a large quantity of platelet and leukocyte cytokines during centrifugation, which stimulate the formation of blood clots and avoid immune rejection and cross-infection.

## MATERIALS AND METHODS

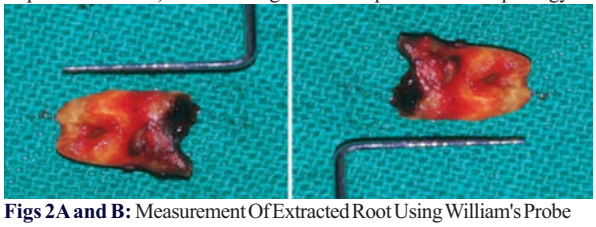
The patients for this study were selected from the out-patient department of the Department of Dentistry, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar. The study was conducted on adults from local population, who required replacement of dentition, which was indicated for extraction with endosseous implants. A total of 20 sites were selected and randomly divided into two groups. Of these, 10 immediate implants were placed with PRF (test group), while the other 10 immediate implants were placed without any similar adjunct (control group). The inclusion criteria were minimum age of 18 years, presence of maxillary or mandibular tooth, which was indicated for extraction without any active infection, presence of adequate and harmonious gingival architecture with the surrounding dentition, adequate bone volume (bone height and width), and good oral hygiene.

### Methods Of Evaluation

Clinical parameters were assessed during implant placement for clinical mobility (using a probe) and perforation of buccal or lingual wall of socket (visual examination). After first stage surgery, we checked for infection (pus discharge), pain, soft tissue dehiscence (cover screw exposure), and loss of sensation on 7th postoperative day. At the time of loading, 3 and 6 months after loading, we checked for plaque index, gingival index, pink esthetic score, and probing depth. Radiographic parameters were assessed immediately after implant placement and at 12 months using CBCT. Radiographic evaluation is done by measuring the perpendicular distance from the most coronal point of the mesial, distal, buccal/labial and lingual/palatal alveolar bone crest to the implant platform immediately after implant placement and 12 months after surgery for vertical bone level, and radiographic evaluation is done by measuring the longest horizontal distance from the implant surface to the socket wall on the mesial, distal, buccal/labial, and lingual/palatal surface immediately after implant placement and 12 months after surgery for horizontal defect distance (HDD) (Figs. 1A and B). Statistical analysis was done using unpaired or independent t-test. Another case in the esthetic zone shows change in peri-implant bone morphology.



**Figs 1A and B:** Superimposition Of Images At Different Times (white—immediate After Implant Placement; Yellow—12 Months After Implant Placement) Shows Change In Peri-implant Bone Morphology



**Figs 2A and B:** Measurement Of Extracted Root Using William's Probe

**Fig. 3:** Implant With Cover Screw Is Placed With Platelet Rich Fibrin
**Fig. 4:** Implant With Cover Screw Is Placed Without Platelet Rich Fibrin

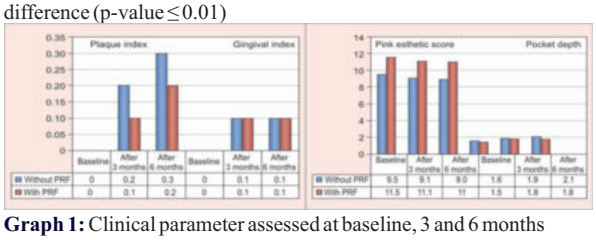
## RESULTS

In our study, a total of 20 implants were placed in 14 patients, 8 were males (57%) and 6 were females (43%) and randomly divided into two groups. Of these, 10 immediate implants were placed with PRF, while the other 10 immediate implants were placed without any similar adjunct. Clinical mobility was checked with a William's probe, and the presence of any bony perforation was noted. No implant mobility and perforations were noted in any case from both the groups. Clinical evaluation of the implant 7 days after stage I surgery was carried out and no Infection (pus discharge) or paresthesia was observed in any case from both the groups. How- ever, a significant finding was the relative absence of cover screw exposure in the test group and presence of cover screw exposure in six cases in the control group. In both groups, there was no loss of sensation, and postoperative inflammation resolved by the 7th day (Table 1). Clinical evaluation of the implants 6 months after stage I surgery showed good periodontal and esthetical status. There was absence of plaque, bleed- ing on probing, pus discharge, clinical mobility, peri-implant probing depth ranging from 1 to 2 mm, and pink esthetic score ranging from 9 to 12 in both groups. Clinical evaluation of the implants 3 months after stage II surgery (post loading) during function showed good periodontal and esthetical status. Again there was absence of plaque, bleeding on probing, pus discharge, clinical mobility, probing depth ranging from 1 to 3 mm, and pink esthetic score ranging from 8 to 12 in both groups. Clinical evaluation of the implants 6 months after stage II surgery (postloading) during function was per- formed. Again, healthy periodontal status was observed in all the cases. On evaluating patient's full mouth plaque scores using the plaque index, the mean plaque index, mean gingival index, and mean pocket depth were found to be statistically insignificant (p-value > 0.05). The gingiva around the implant surface (the pink esthetic zone) appeared healthy, and well developed in all the subjects in the test group as compared with control group. The pink esthetic score was found to be significantly more in test group in comparison with control group at baseline, 3 and 6 months (Table 1 and Graphs 1 and 2). Radiographic evidence from the time of implantation to 12 months after implant placement was obtained. Measurements were done using CBCT and show a relatively higher amount of crestal bone loss in control group. In most instances, the HDD was more than 2 mm. However, in case where PRF was used to fill HDD of more than 2 mm, a complete resolution of the space was seen. On the contrary, when a HDD of 2 mm was left unfilled around an implant from the control group, complete bony regeneration did not take place until after 12 months of healing. The mean crestal/vertical bone change around the implant surface at baseline and 12 months using the unpaired t test was evaluated. The mean crestal/vertical bone change was 0.88 mm on mesial, 0.85 mm on distal, 0.99 mm on buccal and 0.97 mm on palatal side in control group as compared with 0.45, 0.44, 0.40 mm, and 0.52 mm in test group. The mean difference was found to be statistically significant ($p < 0.5$) (Table 2 and Graph 3). The mean HDD was lesser among the test group as compared with control group at 12 months. The mean difference was found to be statistically significant ($p < 0.5$) (Table 3 and Graph 4).

**Table 1: Clinical Parameter Assessed At Baseline, 3 And 6 Months**

| | Groups | Mean | Standard deviation | t-test value | p-value | Mean difference |
|---|---|---|---|---|---|---|
| Plaque index (baseline) | Control group | 0 | 0 | 0 | 1.000 | 0 |
| | Test group | 0 | 0 | | | |
| Plaque index (after 3 months) | Control group | 0.20 | 0.42 | 0.600 | 0.556 | 0.10 |
| | Test group | 0.10 | 0.32 | | | |
| Plaque index (after 6 months) | Control group | 0.30 | 0.48 | | | 0.10 |
| | Test group | 0.20 | 0.42 | | | |
| Gingival index (baseline) | Control group | 0 | 0 | 0 | 1.000 | 0 |
| | Test group | 0 | 0 | | | |
| Gingival index (after 3 months) | Control group | 0.10 | 0.32 | 0 | 1.000 | 0 |
| | Test group | 0.10 | 0.32 | | | |
| Gingival index (after 6 months) | Control group | 0.10 | 0.32 | 0 | 1.000 | 0 |
| | Test group | 0.10 | 0.32 | | | |
| Pink esthetic score (baseline) | Control group | 9.50 | 0.53 | −8.485 | 0*** | −2.00 |
| | Test group | 11.50 | 0.53 | | | −2.00 |
| Pink esthetic score (after 3 months) | Control group | 9.10 | 0.88 | −6.061 | 0*** | |
| | Test group | 11.10 | 0.57 | | | |
| Pink esthetic score (after 6 months) | Control group | 9.00 | 0.82 | −6.000 | 0*** | −2.00 |
| | Test group | 11.00 | 0.67 | | | |
| Pocket depth (baseline) | Control group | 1.60 | 0.52 | 0.429 | 0.673 | 0.10 |
| | Test group | 1.50 | 0.53 | | | |
| Pocket depth (after 3 months) | Control group | 1.90 | 0.57 | 1.236 | 0.232 | 0.30 |
| | Test group | 1.60 | 0.52 | | | |
| Pocket depth (after 6 months) | Control group | 2.10 | 0.57 | 1.116 | 0.279 | 0.30 |
| | Test group | 1.80 | 0.63 | | | |

Unpaired or independent t test; #Non-significant difference (p-value > 0.05); *Significant difference (p-value ≤ 0.05); **Highly significant difference (p-value ≤ 0.01)




**Graph 1:** Clinical parameter assessed at baseline, 3 and 6 months
**Graph 2:** Clinical parameter assessed at baseline, 3 and 6 months

**Table 2: Crestal Bone Change From Time Of Implantation To 12 Months**

| Crestal/ vertical bone change | Time interval | Mean | Standard deviation | t-test value | p-value | Mean difference |
|---|---|---|---|---|---|---|
| *Control group* Mesial | Baseline | 2.73 | 1.33 | −0.289 | 0.776# | 0.88 |
| | 12 months | 1.85 | 1.30 | −0.991 | 0.335# | |
| Distal | Baseline | 2.43 | 1.04 | −0.098 | 0.923 | 0.85 |
| | 12 months | 1.58 | 1.04 | −0.838 | 0.413 | |
| Buccal/facial | Baseline | 2.75 | 1.49 | 0.332 | 0.744 | 0.99 |
| | 12 months | 1.76 | 1.35 | 0.632 | 0.535 | |
| Lingual/ palatal | Baseline | 2.38 | 1.17 | 0.276 | 0.786 | 0.97 |
| | 12 months | 1.41 | 0.95 | −0.840 | 0.412 | |

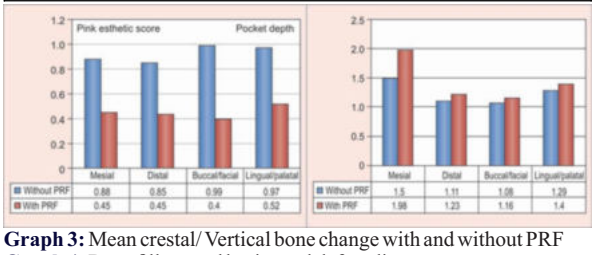
| | | | | | | |
|---|---|---|---|---|---|---|
| *Test group* Mesial | Baseline | 2.91 | 1.33 | −0.289 | 0.776# | 0.45 |
| | 12 months | 2.46 | 1.46 | −0.991 | 0.335# | |
| Distal | Baseline | 2.49 | 1.45 | −0.098 | 0.923 | 0.44 |
| | 12 months | 2.04 | 1.41 | −0.838 | 0.413 | |
| Buccal/facial | Baseline | 2.53 | 1.34 | 0.332 | 0.744 | 0.40 |
| | 12 months | 2.13 | 1.28 | 0.632 | 0.535 | |
| Lingual/ palatal | Baseline | 2.25 | 0.76 | 0.276 | 0.786 | 0.52 |
| | 12 months | 1.73 | 0.76 | −0.840 | 0.412 | |

**Unpaired or independent t test; #Non-significant difference (p-value > 0.05); *Significant difference (p-value ≤ 0.05); **Highly significant difference (p-value ≤ 0.01)**

**Table 3 : The HDD Change From Time Of Implantation To 12 Months**

| Horizontal defect distance | Time interval | Mean | Standard deviation | t-test value | p-value | Mean difference |
|---|---|---|---|---|---|---|
| *Control group* | | | | | | |
| Mesial | Baseline | 1.97 | 1.21 | −0.331 | 0.744 | 1.50 |
| | 12 months | 0.47 | 0.28 | 3.013 | 0.007 | |
| Distal | Baseline | 1.54 | 1.39 | 0.935 | 0.362 | 1.11 |
| | 12 months | 0.43 | 0.22 | 2.837 | 0.011 | |
| Buccal/ facial | Baseline | 1.36 | 0.70 | 0.298 | 0.769 | 1.08 |
| | 12 months | 0.28 | 0.20 | 2.632 | 0.017 | |
| Lingual/ palatal | Baseline | 1.47 | 0.97 | 0.116 | 0.909 | 1.29 |
| | 12 months | 0.18 | 0.14 | 0.916 | 0.372 | |
| *Test group* | | | | | | |
| Mesial | Baseline | 2.17 | 1.42 | −0.331 | 0.744 | 1.98 |
| | 12 months | 0.19 | 0.10 | 3.013 | 0.007 | |
| Distal | Baseline | 1.36 | 0.81 | 0.935 | 0.362 | 1.23 |
| | 12 months | 0.13 | 0.06 | 2.837 | 0.011 | |
| Buccal/ facial | Baseline | 1.26 | 0.89 | 0.298 | 0.769 | 1.16 |
| | 12 months | 0.10 | 0.10 | 2.632 | 0.017 | |
| Lingual/ palatal | Baseline | 1.51 | 0.70 | 0.116 | 0.909 | 1.40 |
| | 12 months | 0.11 | 0.18 | 0.916 | 0.372 | |

Unpaired or independent t test; #Non-significant difference (p-value > 0.05); *Significant difference (p-value ≤ 0.05); **Highly significant difference (p-value ≤ 0.01)




**Graph 3:** Mean crestal/ Vertical bone change with and without PRF
**Graph 4:** Bone fill around horizontal defect distance

## DISCUSSION

Dental implant therapy is one of the pioneering treatment modalities for replacement of missing teeth. Bone loss after tooth extraction remains an important issue in dentistry. Anatomically, bone resorption occurs both buccolingually and apicocoronally, and the first 3 months postextraction are critical carrying the highest rate of bone resorption in either direction. Schorpp et al[3] demonstrated that major changes in bone volume take place during the first 12 months after extraction, with a reduction of 50% of the initial volume, and two-third of this reduction occurring in first 3 months. Placement of an implant directly into a prepared extraction socket at the time of extraction has several advantages[4] that have the potential to improve patient acceptance of the procedure: Elimination of the waiting period for socket ossification, fewer surgical sessions required, shortened edentulous time period, reduced overall cost, and preservation of alveolar bone height and width allowing for optimal placement in relation to implant length, width, and angulation. However, despite these advantages, there are also several potential surgical difficulties[5] and prosthetic complications.[6] These may include complicated extractions, perforation of the cortical plate, problems associated with flap closure, angular bone loss because of periodontal disease, technique-sensitive procedure, reduced vestibular depth, angulations prob- lems, and deep or shallow implant placement within the socket. In the intact socket, a critical component of the peri-implant defect is the size of the horizontal defect, which is the longest distance in a perpendicular direction from the implant surface to the socket wall. This distance is known as jumping distance or HDD and needs to be filled with bone or a filling substitute to achieve an optimal outcome. Bone healing and consequently osseointegration is dependent on stabilization of the initially formed coagulum in this space. Animal experimental studies have shown that both the distances from the bone to the implant and the surface characteristic of the implant are critical factors for stabilization of the coagulum. It has been shown that for implants with horizontal defect of 2 mm or less, spontaneous bone healing and osseointegration takes place if the implant has a rough surface.[7,8] Horizontal defects in excess of 2 mm have been shown to not heal predictably. However, it is possible to achieve success in such situations by filling the defects with bone (autogenous or allograft) and covering with collagen barrier membranes.[9] In the present study, we observed the outcome of implants placed in fresh extraction sockets with the use of Choukroun PRF for filling the jumping distance.

It is autogenous and is not associated with any issues related to immune reactions or infections. Besides, its gelatinous consistency enhances clot and graft stability. Platelets release cytokines, such as platelet-derived growth factor (PDGF), insulin-like growth factor (IGF), and vascular endothelial growth factor (VEGF). The PDGF and IGF are well-known osteogenic cytokines. Choukroun PRF is known to release growth factors for at least 7 days. Thus, this biomaterial presents a specific biology, which offers several advantages including promoting wound healing, bone growth and maturation, graft stabilization, wound sealing and hemostasis, and improving the handling properties of graft materials.[10-14] The main characteristics of PRF compared with other platelet concentrates, including platelet-rich plasma, are that it does not require any anticlotting or gellifying agent, the naturally forming PRF clot has a dense and complex three-dimensional architecture, and this type of clot concentrates not only platelets, but also leukocytes. Based on these characteristics, PRF is simpler and less expensive to prepare, as well as being less risky to patients because it does not expose them to animal-derived anticlotting agents. Finally, by virtue of containing leukocytes, PRF may exert an antibacterial effect in the wound and work as an abundant source of VEGF, which is the key player in angiogenesis.[15,20-22] At the time of insertion, both groups showed adequate primary stability. Thus, we were able to quantitatively determine that we were fulfilling the basic criteria for success of immediate implants, i.e., mechanical stability by engaging the socket walls or bone 2 to 4 mm apical to the socket depth.[13,16] It was observed in this study that as compared with the control group, patients in the PRF group showed better soft tissue healing. This was ascertained by observing cover screw exposure on the seventh postimplantation day. While implants placed with PRF were mostly covered by healthy mucosa, 6 out of 10 cases from control group demonstrated cover screw exposure.[17] The PRF represents a new technology for stimulation and acceleration of bone regeneration without any risk of infection or transmission of diseases as PRF is an autologous source of growth factors, prepared by simple technique, minimal cost, and is minimally invasive.[11] Plaque index and gingival index are recommended for the evaluation of oral hygiene practices and the status of the peri-implant mucosa. According to our results, the mean plaque index for full mouth and implant, for both groups was not statistically significant ($p > 0.05$). This can be attributed to the plaque control by the patient and the repeated reinforcements of oral hygiene measures given to the patient by the clinician.[18,23,27,28] In the present study, it was observed that the mean pink esthetic score was ± 0.82 in control group as compared with 11.00 ± 0.67 in test group. According to our results, the mean difference between both groups was statistically significant.[12,13] A significant limitation of this parameter was that the pink esthetic score at baseline, 3 and 6 months was assessed by single observer. The scoring would have been concrete if the assessment was done by three to four observers and mean score would have been recorded. The CBCT is an advanced digital radiographic technique proposed for implant treatment planning. A significant limitation of CBCT imaging is the presence of metal artifacts, i.e., image flaws that are unrelated to the scanned object, which are caused by metal and amalgam restorations and, to a lesser extent, root canal filling material and implants. Such artifacts include

streaks around materials as well as dark zones that affect the overall quality of the image. Streak artifacts appear as linear hyperdensities that radiate from a metallic object and may extend to the width of the field, affecting visualization of areas even on the opposite side of an image. Beam hardening artifacts, which appear as dark bands adjacent to high-density structures, may mimic disease. The bone loss occurred may be a result of irritation from plaque accumulation, and natural bone remodeling around the implant as a sequel for placement of final prosthesis that may be associated with increased load and, in turn, increased transferred stress on bone implant interface.[24-26,28] The mean difference in crestal/vertical bone change from baseline to 12 months was significantly lesser among the test group in comparison with the control group.[11,19]

## CONCLUSION

Based on clinical and radiographic evaluation, we conclude that immediate implant placement following tooth extraction has been found to be a viable and predictable solution to tooth loss. Minimally invasive surgical technique, ease of procedure, and shorter time involved together with minimum postextraction complications are the important advantages of this method. However, proper case selection and meticulous postoperative care preceded by good surgical and prosthetic protocol are the essentials for success. The PRF favors rapid soft tissue regeneration, diminishes crestal/vertical bone loss, and improves early wound closure, which helps in achieving an esthetic outcome and better patient acceptance.

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