



A COMPARATIVE CLINICO-RADIOGRAPHIC EVALUATION OF IMMEDIATE DENTAL IMPLANTS BIOACTIVATED WITH PLATELET-RICH PLASMA VERSUS NON-BIOACTIVATED IMPLANTS: A RANDOMIZED CONTROLLED CLINICAL STUDY

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ABSTRACT

Background: Immediate dental implant placement has become an increasingly preferred treatment modality owing to reduced treatment time, preservation of alveolar bone, and enhanced patient satisfaction. However, achieving predictable osseointegration and maintaining peri-implant tissue stability remain major challenges. Platelet-rich plasma (PRP), an autologous concentrate rich in growth factors, has been proposed as a biological adjunct to enhance early bone healing and soft-tissue response around implants.

Aim: To compare the clinical and radiographic outcomes of immediate dental implants treated with platelet-rich plasma (PRP) and those placed without PRP.

Materials and Methods: This randomized controlled clinico-radiographic study was conducted on 10 systemically healthy patients requiring extraction and immediate implant placement in the anterior region. A total of 20 implants were placed and randomly allocated into two groups: Group A (control group, non-PRP treated implants) and Group B (test group, PRP-treated implants). Clinical parameters including implant mobility, modified plaque index (MPI), modified sulcus bleeding index (MSBI), and peri-implant probing depth (PIPD) were recorded at baseline, 3 months, and 6 months post-loading. Radiographic assessment of crestal bone loss (CBL) was performed using standardized intraoral periapical radiographs. Statistical analysis was carried out using SPSS software.

Results: Both groups demonstrated successful osseointegration with no implant mobility throughout the study period. Although plaque accumulation and probing depth increased in both groups over time, PRP-treated implants showed comparatively better peri-implant tissue response. Radiographically, crestal bone loss at 6 months was significantly lower in the PRP group compared to the control group ($p < 0.01$).

Conclusion: Bioactivation of immediate dental implants with PRP may enhance early peri-implant healing and significantly reduce crestal bone loss when compared to non-PRP-treated implants.

Keywords: Immediate implant, Platelet-rich plasma, Osseointegration, Crestal bone loss, Dental implants

INTRODUCTION

Replacement of missing teeth has remained a central goal of restorative dentistry for centuries. Conventional prosthetic modalities such as removable partial dentures and fixed partial dentures, although widely used, often involve the sacrifice of healthy tooth structure, compromised esthetics, limited retention, and psychological dissatisfaction [1]. These limitations paved the way for dental implants, which have revolutionized oral rehabilitation by providing a predictable and long-term solution for partial and complete edentulism.

The concept of osseointegration, introduced by Brånemark, established the biological basis for implant success, defined as a direct structural and functional connection between living bone and the surface of a load-bearing implant. Traditionally, implant placement followed a delayed protocol, allowing several months of healing after tooth extraction. However, this delay often results in significant alveolar bone resorption, increased treatment duration, and patient discomfort [2,3].

Immediate implant placement, defined as placement of an implant at the time of tooth extraction, has gained increasing popularity due to its advantages, including preservation of alveolar bone architecture, reduced number of surgical procedures, shortened treatment time, and improved esthetic outcomes [4]. Despite these benefits, immediate implants present biological challenges such as incomplete socket healing, gap formation between implant and socket walls, and difficulty in achieving predictable soft-tissue stability.

Bone healing around implants is a complex biological process regulated by cellular migration, angiogenesis, and release of growth factors. Enhancing this healing cascade has been the focus of extensive research. Autologous platelet concentrates, particularly platelet-rich plasma (PRP), have emerged as promising adjuncts due to their high concentration of biologically active growth factors such as platelet-derived growth factor (PDGF), transforming growth factor- β (TGF- β), vascular endothelial growth factor (VEGF), and fibroblast growth factor (FGF) [5].

PRP is derived from the patient's own blood and provides a fibrin scaffold that facilitates cellular adhesion, proliferation, and differentiation. Experimental and clinical studies have demonstrated that PRP may accelerate soft-tissue healing, enhance bone regeneration, and improve early osseointegration. When applied to implant surfaces, PRP forms a biologically active layer that modifies initial implant-tissue interactions [6-8].

Despite encouraging evidence from animal and in vitro studies, limited human clinical trials have evaluated the role of PRP in immediate implant placement. Therefore, the present study was undertaken to clinically and radiographically compare immediate implants treated with PRP and those placed without PRP, with emphasis on peri-implant soft tissue health and crestal bone stability [10].

MATERIALS AND METHODS

This randomized controlled clinical study was conducted in the Department of Periodontology and Implantology, Sardar Patel Post Graduate Institute of Dental & Medical Sciences, Lucknow, after obtaining ethical clearance and informed consent from all participants.

Study Population

Ten systemically healthy patients requiring extraction and immediate implant placement in the anterior region were selected. A total of 20 implants were placed.

Grouping

- **Group A (Control Group):** Immediate implants placed without PRP surface treatment
- **Group B (Test Group):** Immediate implants placed after bioactivation with PRP

Inclusion Criteria

1. Systemically healthy individuals aged 20–55 years
2. Patients requiring immediate implant placement
3. Adequate bone quality and quantity
4. Good oral hygiene maintenance
5. Written informed consent

Exclusion Criteria

1. Pregnant or lactating women
2. Smokers and tobacco users
3. Systemic diseases affecting healing
4. Untreated periodontitis
5. Periapical pathology
6. Parafunctional habits
7. Patients on anticoagulant therapy

Clinical and Radiographic Parameters

1. Implant Mobility
2. Modified Plaque Index (MPI)
3. Modified Sulcus Bleeding Index (MSBI)
4. Peri-Implant Probing Depth (PID)
5. Crestal Bone Loss (CBL) using standardized IOPAR

Results

Baseline Characteristics

In the present study it was noted that Both groups were comparable with respect to age and gender distribution, with no statistically significant difference, indicating proper randomization.

Modified Plaque Index

MPI showed a gradual increase in both groups over time. However, the increase was comparatively lower in the PRP group, indicating better plaque control and peri-implant tissue adaptation.

Modified Sulcus Bleeding Index

MSBI increased significantly at 6 months in the control group, while the PRP group demonstrated comparatively lower bleeding scores, suggesting improved soft-tissue healing with PRP.

The present comparative clinico-radiographic study deals with evaluation of clinical parameters around PRP treated implants vs. Non PRP treated implants. Total 10 systemically healthy subjects aged between 20-55 years either sex was recruited. The subjects were randomized equally into two groups and treated without PRP (Group A) or with PRP (Group B). The outcome measures of the study were modified plaque index (MPI), modified sulcular bleeding index (MSBI), implant mobility (MI), peri implant probing depth (PID) and crestal bone loss (CBL) assessed at baseline (pretreatment) and 3 and 6 month post treatment. The outcome measures PID and CBL were measured in millimeter (mm). The aim of the study was to compare and correlate clinical and radiographic changes around PRP treated implants before placement Vs non PRP treated implants in the cases of implant supported prosthesis i.e. to compare the outcome measures between two groups over the periods (time).

Basic characteristics

The basic characteristics (age and sex and site of implant) of two groups is depicted in Fig. 1 to 2 respectively. The age of Group A and Group B subjects ranged from 25-42 yrs and 22-42 yrs respectively with mean ($\pm$ SE) 33.40 ± 1.85 yrs and 32.50 ± 2.38 yrs respectively and median 33

yrs. The mean age of Group A was slightly higher than Group B. Comparing the mean age of two groups, Student's t test showed similar ($p>0.05$) age between the two groups i.e. did not differed significantly. Further, in both groups, there were 6 (60%) males and 4 (40%) females.

Table 1: Basic characteristics of two groups

Basic characteristics	Group A (n=10) (%)	Group B (n=10) (%)	t/ χ^2 value	p value
Age (yrs): Mean $\pm$ SE	33.40 $\pm$ 1.85	32.50 $\pm$ 2.38	0.30	0.769

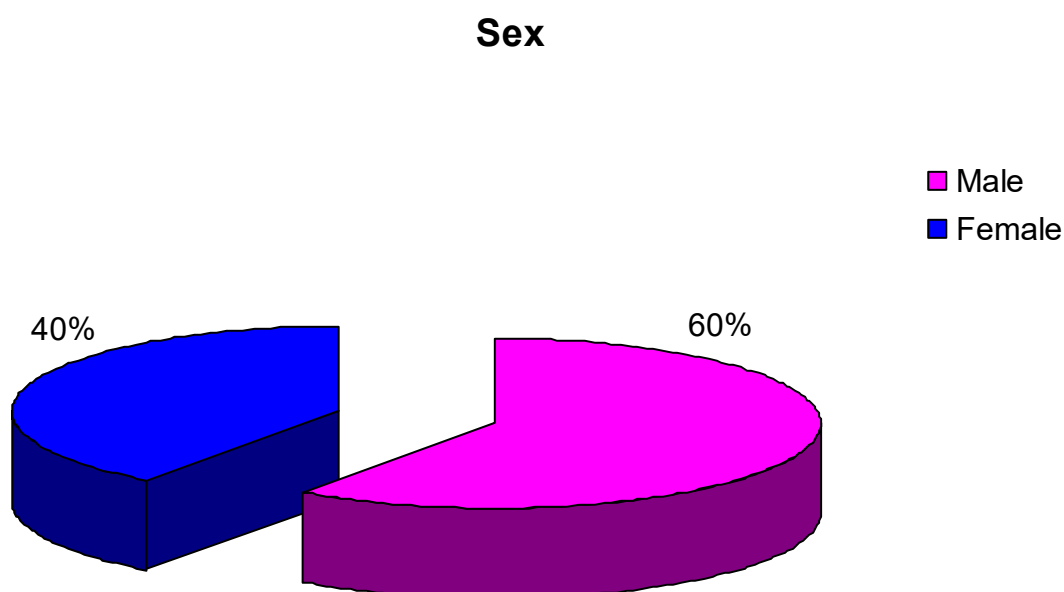
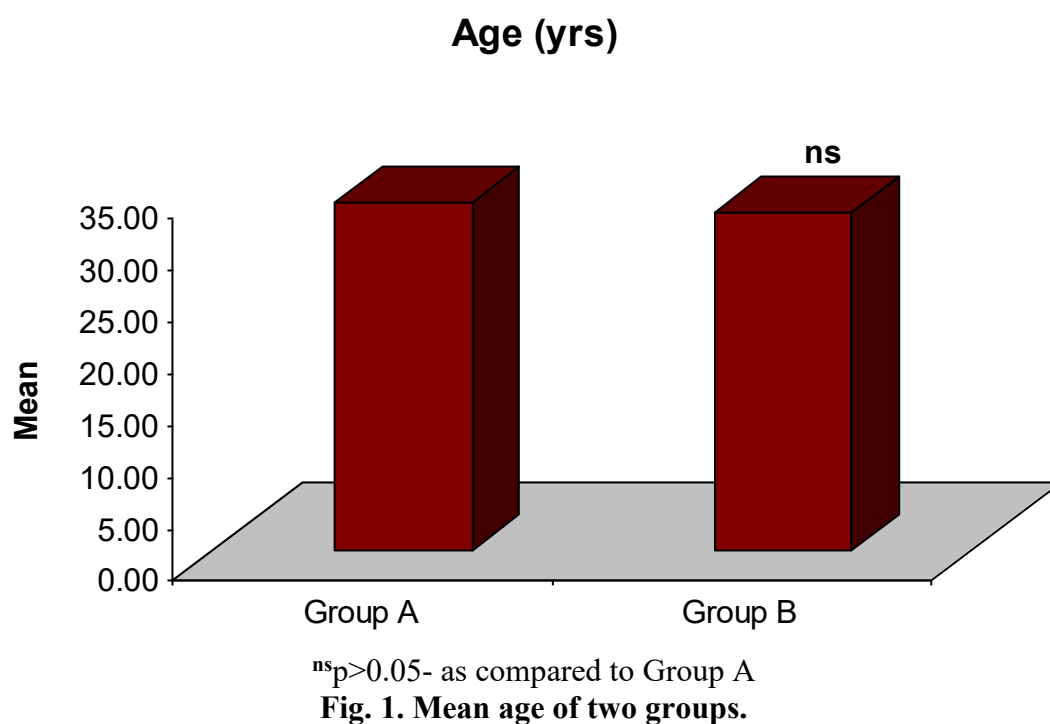


Fig. 2. Distribution of sex of two group

Outcome measures

I. Modified plaque index

The pre (baseline) and post (3 and 6 month) modified plaque index (MPI) of two groups (Group A and Group B) is summarized in Table 2 and also shown in Fig. 4. In both groups, the mean MPI increase after the treatment and the increase was evident almost similar between the two groups though at all periods, the mean MPI was slightly higher in Group A than Group B.

For each group, comparing the mean MPI between the periods (Table 3 and Fig. 5), Tukey test showed similar ($p>0.05$) MPI between the periods in both groups i.e. did not differ ($p>0.05$) significantly.

Similarly, for each period, comparing the mean MPI between the groups (Table 4 and Fig. 6), Tukey test showed similar ($p>0.05$) MPI between the groups at all periods i.e. did not differ significantly.

However, at final evaluation, the net increase (i.e. mean change from baseline to 6 month) in MPI of Group B (50.0%) was found 7.1% higher than Group A (42.9%).

Table 2: Pre and post MPI (Mean $\pm$ SD) of two groups over the periods

Time periods	Group A (n=10)	Group B (n=10)
Baseline	0.40 $\pm$ 0.16	0.30 $\pm$ 0.15
3 month	0.70 $\pm$ 0.15	0.60 $\pm$ 0.16
6 month	0.70 $\pm$ 0.15	0.60 $\pm$ 0.16

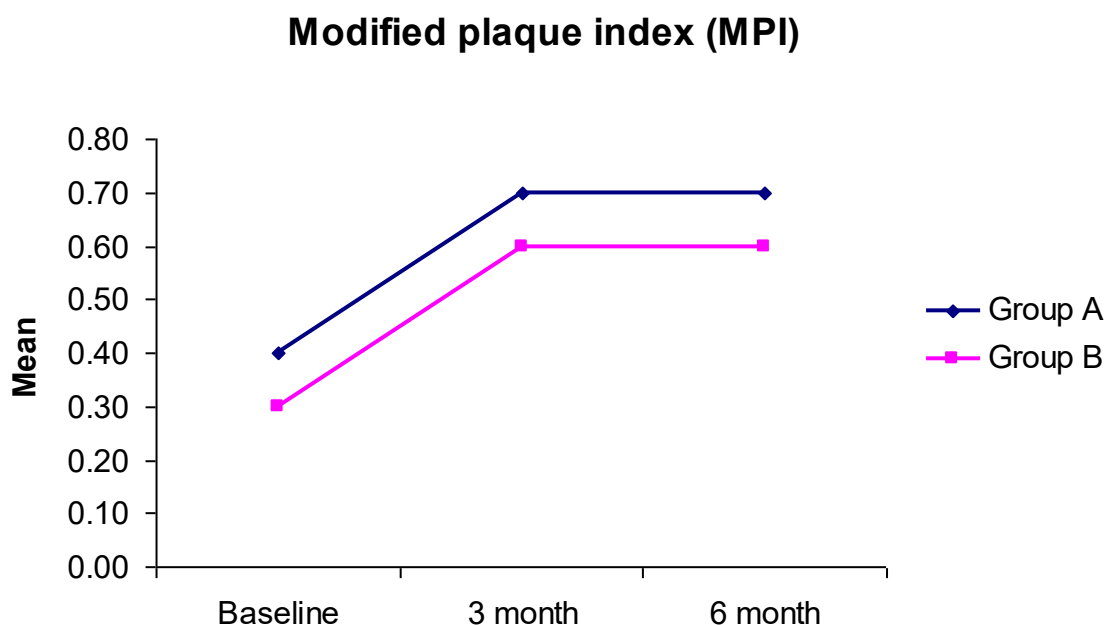


Fig. 4. Mean MPI of two groups over the periods.

Table 3: For each group, comparison (p value) of difference in mean MPI between the periods by Tukey test

Comparison	Group A		Group B	
	Mean diff	p value	Mean diff	p value
Baseline vs. 3 month	0.30	0.434	0.30	0.211
Baseline vs. 6 month	0.30	0.328	0.30	0.328

3 month vs. 6 month	0.00	1.000	0.00	1.000
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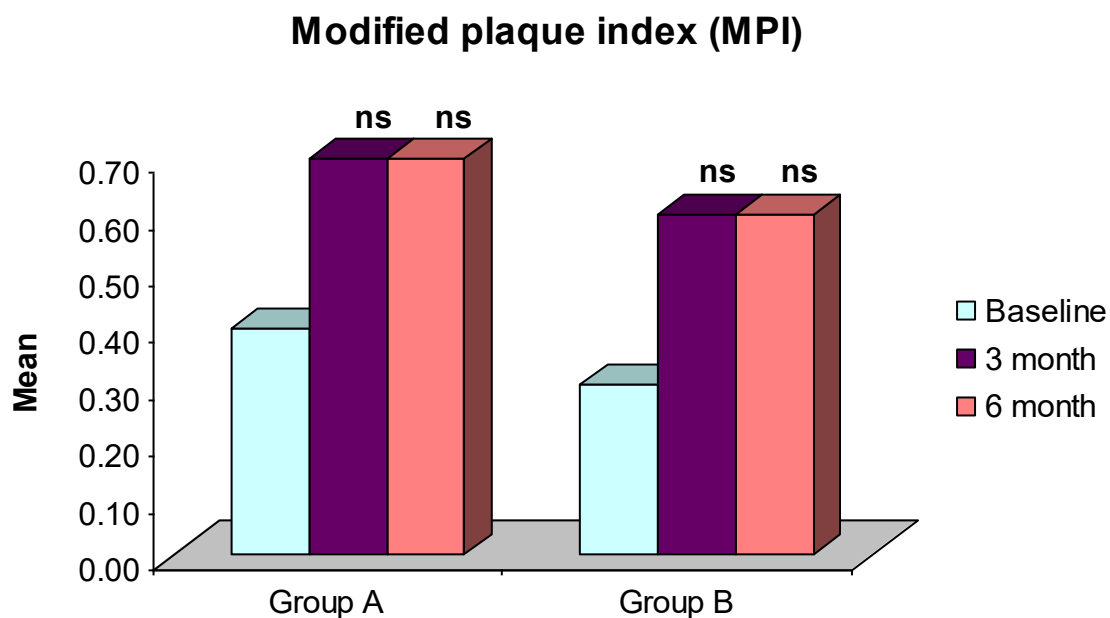
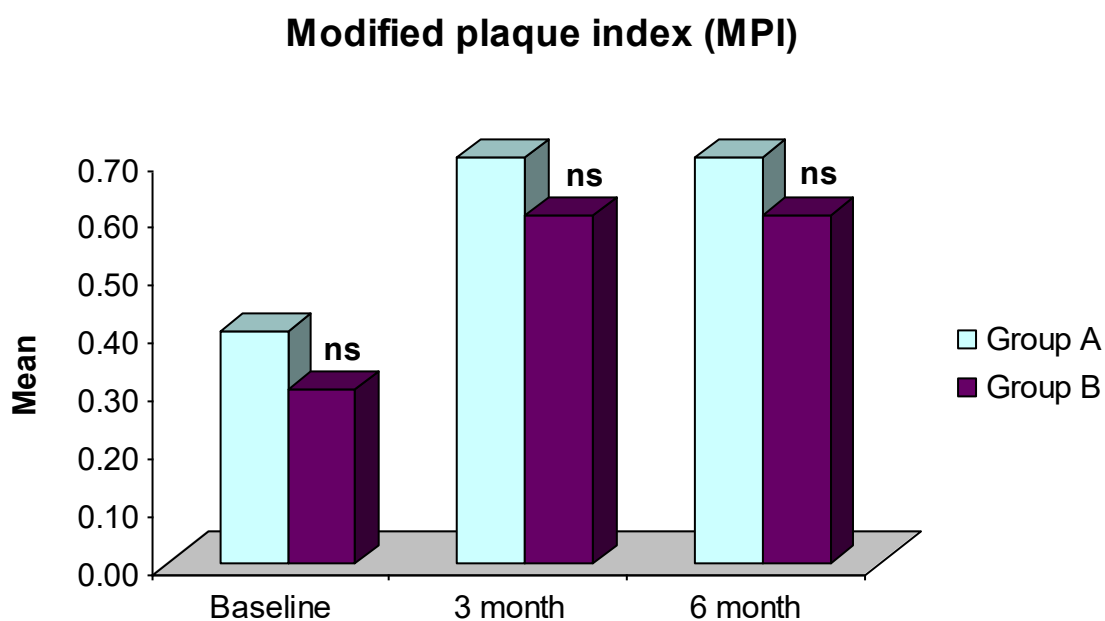


Fig. 5. For each group, comparisons of difference in mean MPI between the periods.

Table 4: For each period, comparison (p value) of difference in mean MPI between the groups by Tukey test

Time period	Comparison (Group A vs. Group B)	
	Mean diff	p value
Baseline	0.10	0.657
3 month	0.10	0.970
6 month	0.10	0.657



^{ns}p>0.05- as compared to Group A

Fig. 6. For each period, comparisons of difference in mean MPI between the groups.

II. Modified sulcular bleeding index

The pre (baseline) and post (3 and 6 month) modified sulcular bleeding index (MSBI) of two groups (Group A and Group B) is summarized in Table 5 and also depicted in Fig. 7. In both groups, the mean MSBI increase after the treatment and at the end the increase was evident slightly higher in Group A than Group B.

For each group, comparing the mean MSBI between the periods (Table 6 and Fig. 8), Tukey test showed significant ($p<0.05$) increase in MSBI at 6 month as compared to baseline in Group A. However, in both groups, it did not differ ($p>0.05$) between other periods i.e. found to be statistically the same.

Similarly, for each period, comparing the mean MSBI between the groups (Table 7 and Fig. 9), Tukey test showed similar ($p>0.05$) MSBI between the groups at all periods i.e. did not differ significantly.

However, at final evaluation, the net increase (i.e. mean change from baseline to 6 month) in MSBI of Group A (100.0%) was found 25.0% higher than Group B (75.0%).

Table 5: Pre and post MSBI (Mean $\pm$ SD) of two groups over the periods

Time periods	Group A (n=10)	Group B (n=10)
Baseline	0.00 $\pm$ 0.00	0.10 $\pm$ 0.10
3 month	0.20 $\pm$ 0.13	0.10 $\pm$ 0.10
6 month	0.50 $\pm$ 0.17	0.40 $\pm$ 0.16

Modified sulcular bleeding index (MSBI)

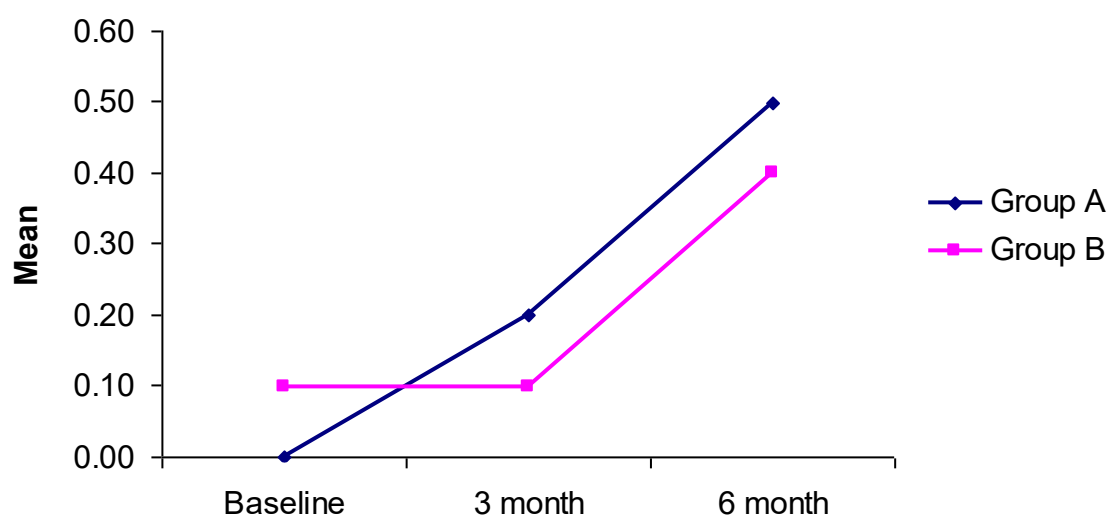
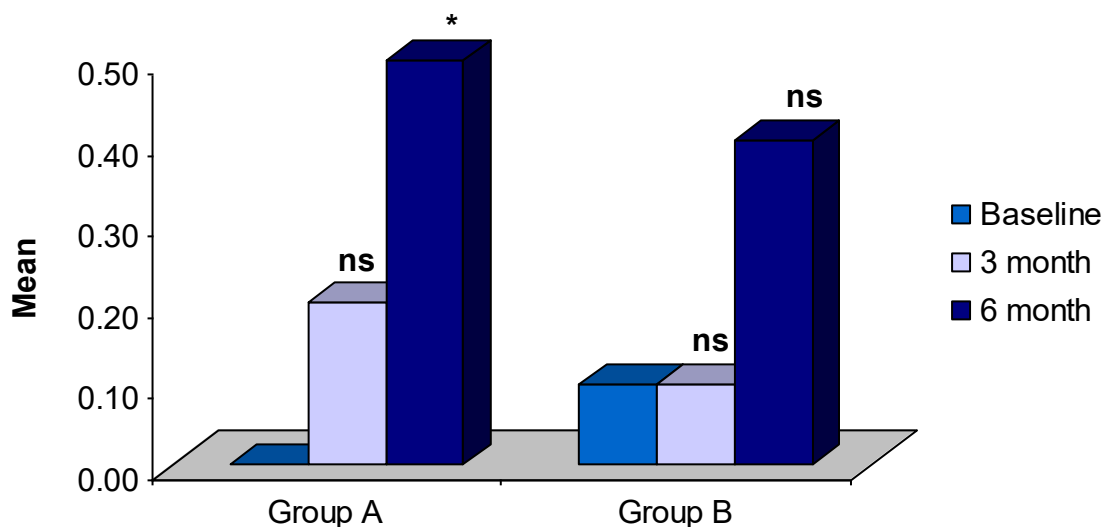


Fig. 7. Mean MSBI of two groups over the periods.

Table 6: For each group, comparison (p value) of difference in mean MSBI between the periods by Tukey test

Comparison	Group A		Group B	
	Mean diff	p value	Mean diff	p value
Baseline vs. 3 month	0.20	0.616	0.00	1.000
Baseline vs. 6 month	0.50	0.044	0.30	0.172
3 month vs. 6 month	0.30	0.172	0.00	0.273

Modified sulcular bleeding index (MSBI)



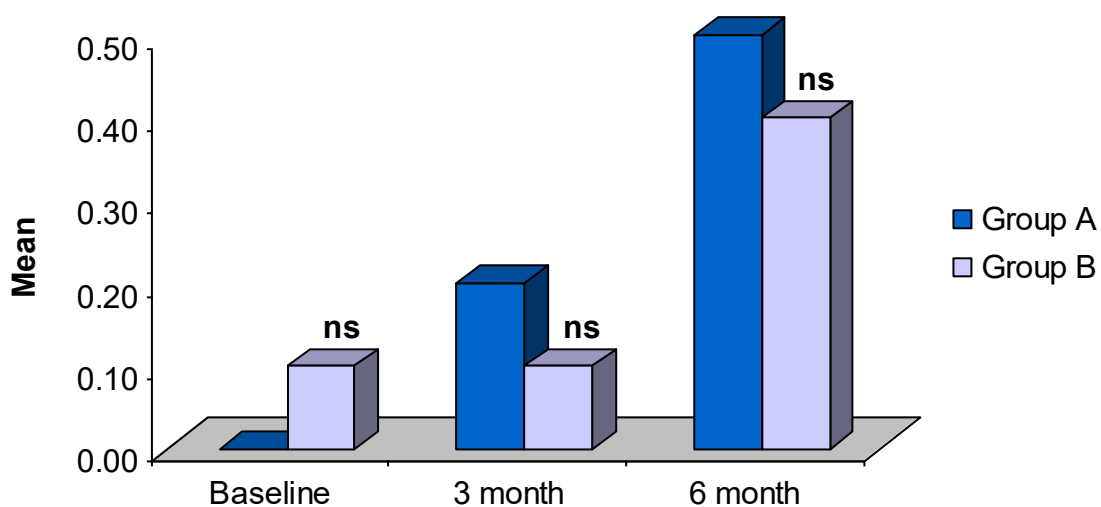
^{ns}p>0.05 or ^{*}p<0.05 - as compared to Baseline

Fig. 8. For each group, comparisons of difference in mean MSBI between the periods.

Table 7: For each period, comparison (p value) of difference in mean MSBI between the groups by Tukey test

Time period	Comparison (Group A vs. Group B)	
	Mean diff	p value
Baseline	0.10	0.837
3 month	0.10	0.837
6 month	0.10	0.571

Modified sulcular bleeding index (MSBI)



^{ns}p>0.05- as compared to Group A

Fig. 9. For each period, comparisons of difference in mean MSBI between the groups.

III. Implant mobility

The pre (baseline) and post (3 and 6 month) implant mobility (IM) of two groups (Group A and Group B) is summarized in Table 8 and also depicted in Fig. 10. In both groups, the mean IM was 0 at baseline, 3 month and 6 month. In other words, the mean IM was similar ($p>0.05$) within (Table 9 and Fig. 11) and between (Table 10 and Fig. 12) the groups.

Table 8: Pre and post IM (Mean $\pm$ SD) of two groups over the periods

Time periods	Group A (n=10)	Group B (n=10)
Baseline	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
3 month	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
6 month	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00

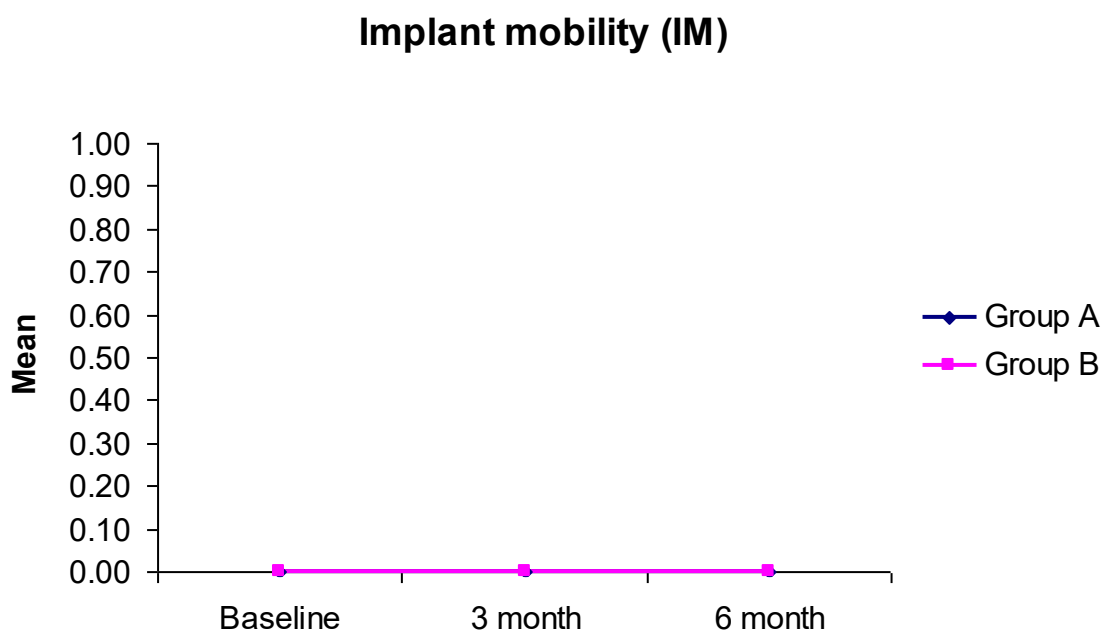


Fig. 10. Mean IM of two groups over the periods.

Table 9: For each group, comparison (p value) of difference in mean IM between the periods by Tukey test

Comparison	Group A		Group B	
	Mean diff	p value	Mean diff	p value
Baseline vs. 3 month	0.00	1.000	0.00	1.000
Baseline vs. 6 month	0.00	1.000	0.00	1.000
3 month vs. 6 month	0.00	1.000	0.00	1.000

Implant mobility (IM)

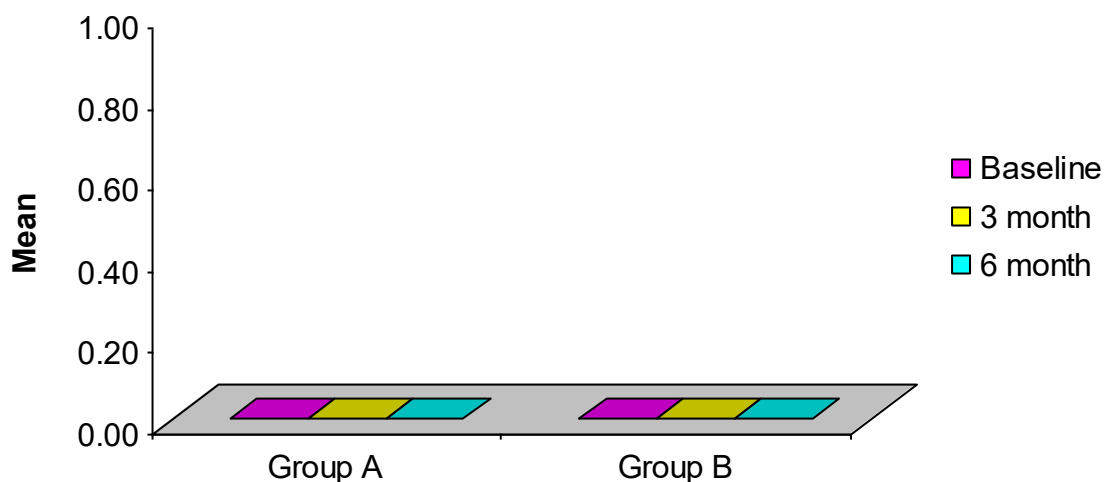


Fig. 11. For each group, comparisons of difference in mean IM between the periods.

Table 10: For each period, comparison (p value) of difference in mean IM between the groups by Tukey test

Time period	Comparison (Group A vs. Group B)	
	Mean diff	p value
Baseline	0.00	1.000
3 month	0.00	1.000
6 month	0.00	1.000

Implant mobility (IM)

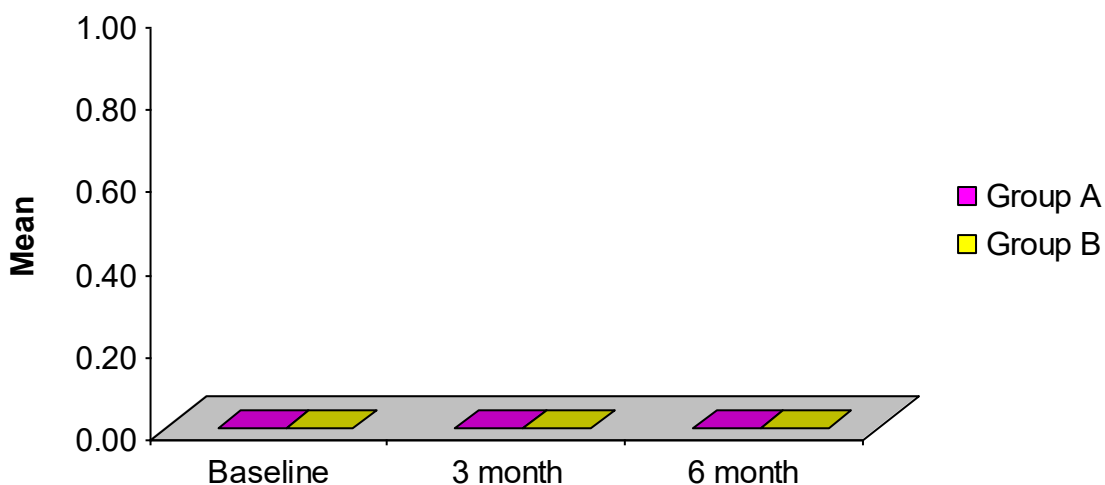


Fig. 12. For each period, comparisons of difference in mean IM between the groups.

IV. Peri implant probing depth

The pre (baseline) and post (3 and 6 month) peri implant probing depth (PIPD) of two groups (Group A and Group B) is summarized in Table 11 and also shown in Fig. 13. In both groups, the mean PIPD increase after the treatment and at the end the increase was evident slightly higher in Group A than Group B.

For each group, comparing the mean PIPD between the periods (Table 12 and Fig. 14), Tukey test showed significant ($p < 0.05$) increase in PIPD at 6 month as compared to baseline in Group A. However, in both groups, it did not differ ($p > 0.05$) between other periods i.e. found to be statistically the same.

Similarly, for each period, comparing the mean PIPD between the groups (Table 13 and Fig. 15), Tukey test showed similar ($p > 0.05$) PIPD between the groups at all periods i.e. did not differ significantly.

However, at final evaluation, the net increase (i.e. mean change from baseline to 6 month) in PIPD of Group A (21.4%) was found 2.2% higher than Group B (19.2%).

Table 11: Pre and post PIPD (Mean $\pm$ SD) of two groups over the periods

Time periods	Group A (n=10)	Group B (n=10)
Baseline	2.20 $\pm$ 0.13	2.10 $\pm$ 0.10
3 month	2.50 $\pm$ 0.17	2.40 $\pm$ 0.16
6 month	2.80 $\pm$ 0.13	2.60 $\pm$ 0.16

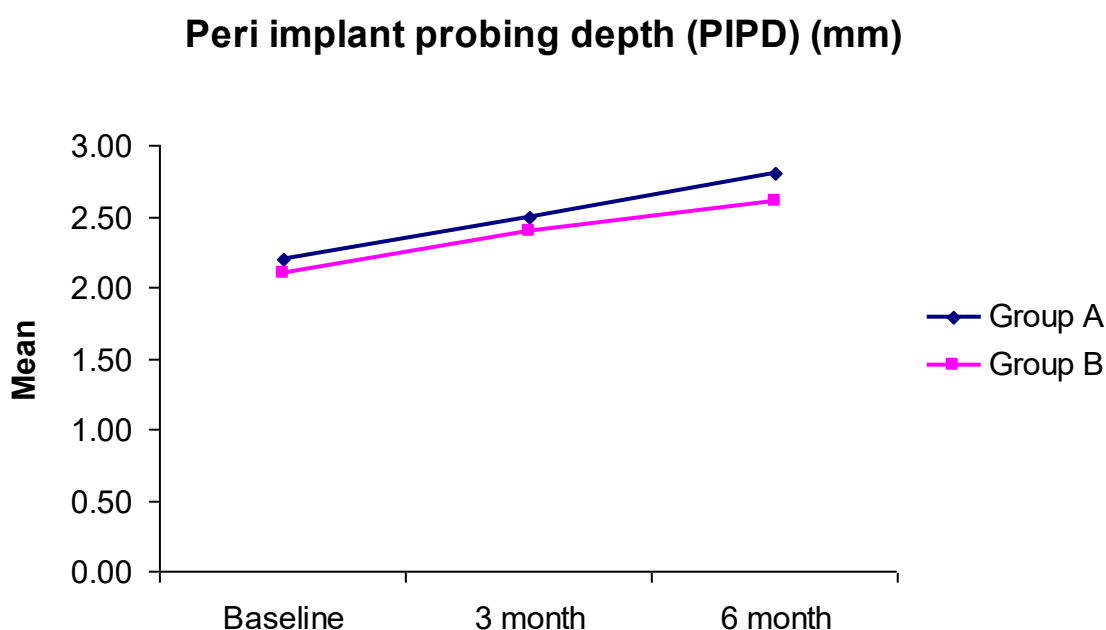
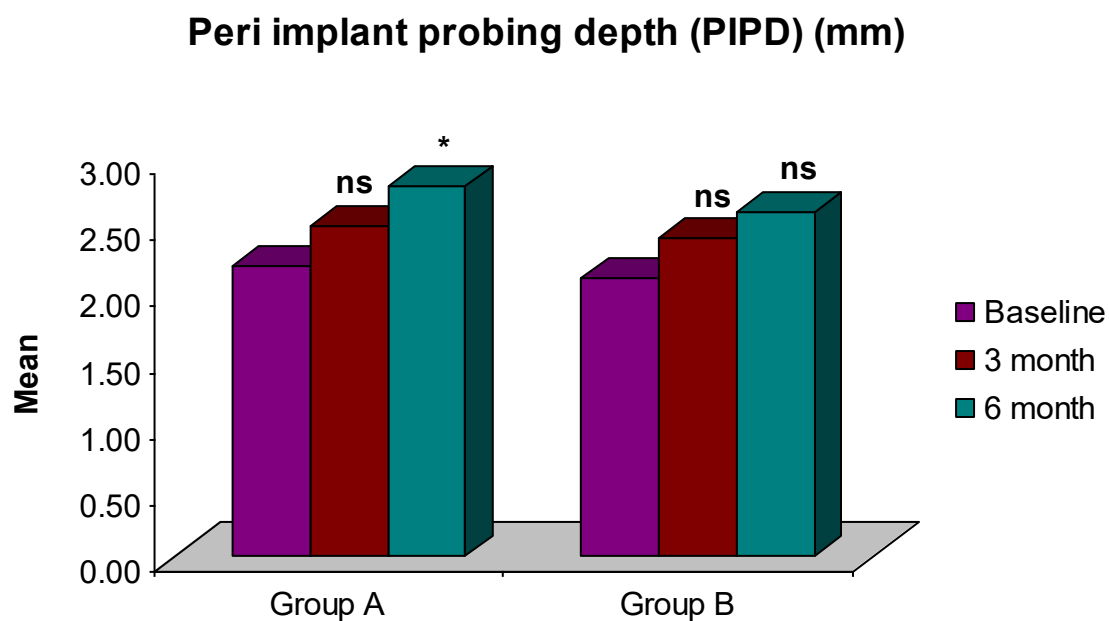


Fig. 13. Mean PIPD of two groups over the periods.

Table 12: For each group, comparison (p value) of difference in mean PIPD between the periods by Tukey test

Comparison	Group A		Group B	
	Mean diff	p value	Mean diff	p value
Baseline vs. 3 month	0.30	0.219	0.30	0.219
Baseline vs. 6 month	0.60	0.014	0.50	0.054
3 month vs. 6 month	0.30	0.219	0.20	0.500

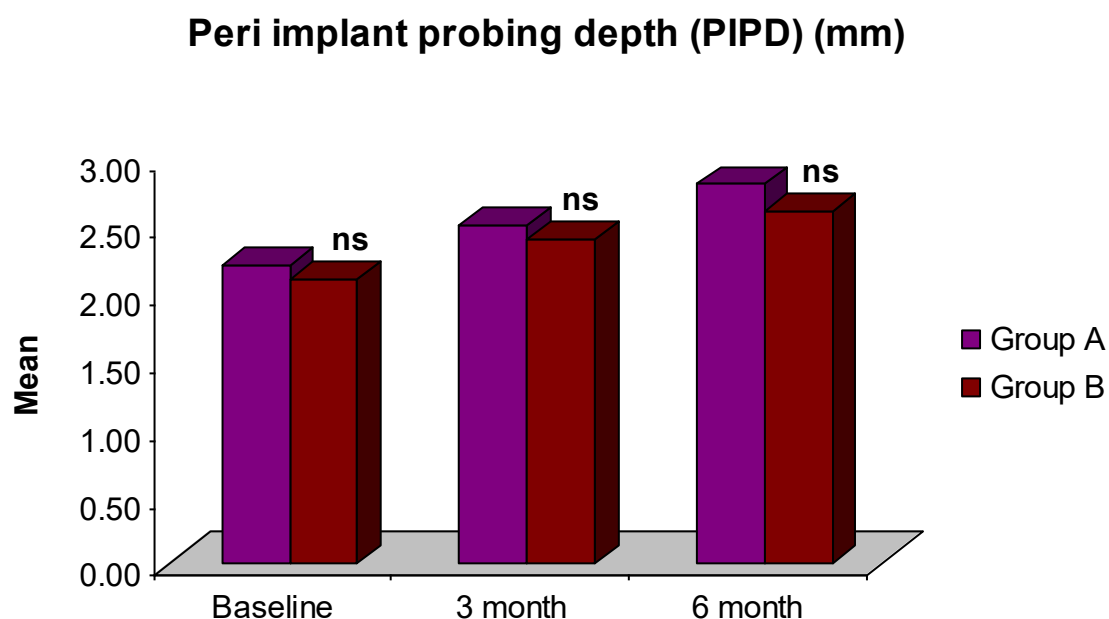


^{ns}p>0.05 or ^{*}p<0.05 - as compared to Baseline

Fig. 14. For each group, comparisons of difference in mean PIPD between the periods.

Table 13: For each period, comparison (p value) of difference in mean PIPD between the groups by Tukey test

Time period	Comparison (Group A vs. Group B)	
	Mean diff	p value
Baseline	0.10	0.629
3 month	0.10	0.629
6 month	0.20	0.335



^{ns}p>0.05- as compared to Group A

Fig. 15. For each period, comparisons of difference in mean PIPD between the groups.

V. Crestal bone loss

The pre (baseline) and post (3 and 6 month) crestal bone loss (CBL) of two groups (Group A and Group B) is summarized in Table 14 and also shown in Fig. 16. In both groups, the mean CBL increase after the treatment and at the end the increase was evident comparatively higher in Group A than Group B.

For each group, comparing the mean CBL between the periods (Table 15 and Fig. 17), Tukey test showed significant ($p<0.001$) increase in CBL at 6 month as compared to both baseline and 3 month in both groups. Further, in Group A, it also increase significantly ($p<0.01$) at 3 month as compared to baseline.

Similarly, for each period, comparing the mean CBL between the groups (Table 16 and Fig. 18), Tukey test showed similar ($p>0.05$) CBL between the groups at baseline and 3 month. However, at 6 month, it was significantly ($p<0.01$) different and higher in Group A as compared to group B.

Moreover, at final evaluation, the net increase (i.e. mean change from baseline to 6 month) in CBL of Group A (50.0%) was found 7.7% higher than Group B (42.3%).

Table 14: Pre and post CBL (Mean ± SD) of two groups over the periods

Time periods	Group A (n=10)	Group B (n=10)
Baseline	0.61 ± 0.03	0.60 ± 0.03
3 month	0.80 ± 0.04	0.73 ± 0.03
6 month	1.22 ± 0.06	1.04 ± 0.06

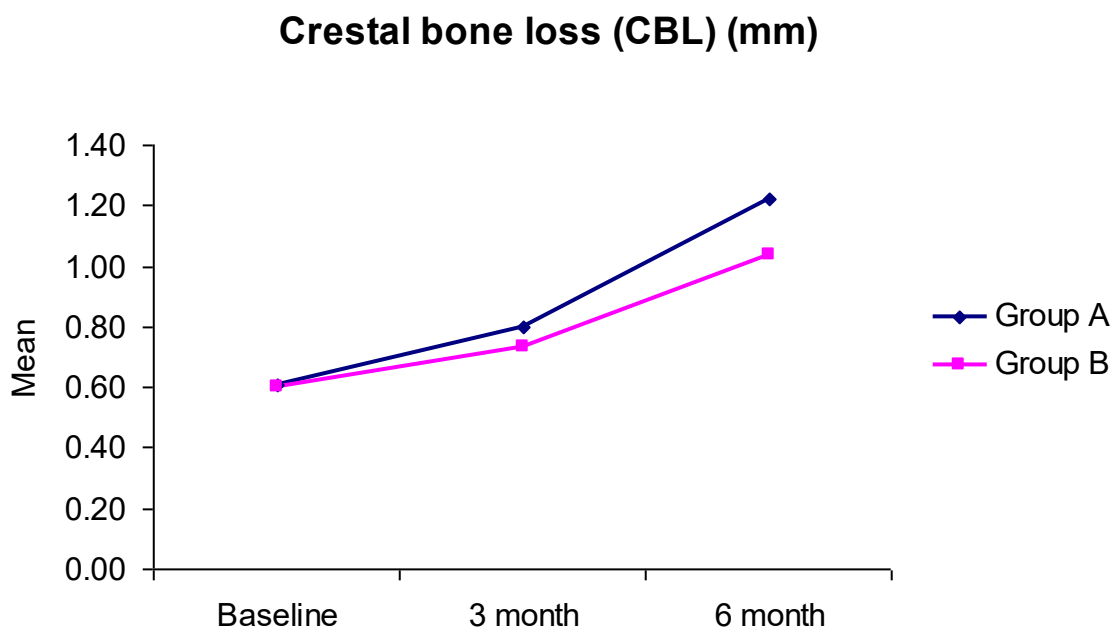
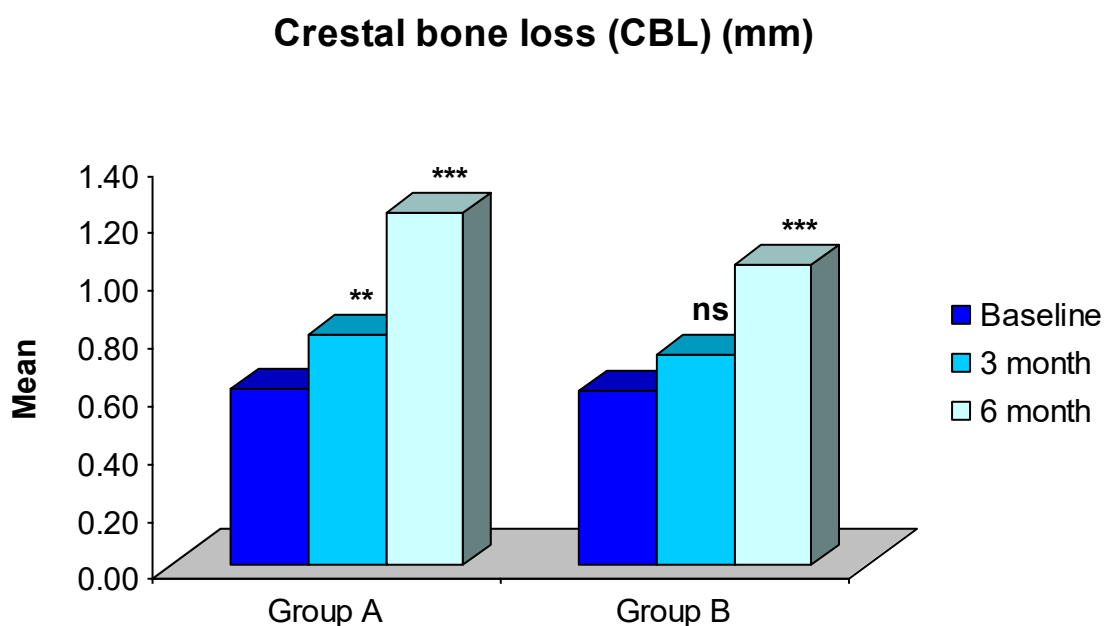


Fig. 16. Mean CBL of two groups over the periods.

Table 15: For each group, comparison (p value) of difference in mean CBL between the periods by Tukey test

Comparison	Group A		Group B	
	Mean diff	p value	Mean diff	p value
Baseline vs. 3 month	0.19	0.008	0.13	0.085
Baseline vs. 6 month	0.61	<0.001	0.44	<0.001
3 month vs. 6 month	0.42	<0.001	0.31	<0.001



ns p>0.05 or ** p<0.01 or *** p<0.001 - as compared to Baseline

Fig. 17. For each group, comparisons of difference in mean CBL between the periods.

Table 16: For each period, comparison (p value) of difference in mean CBL between the groups by Tukey test

Time period	Comparison (Group A vs. Group B)	
	Mean diff	p value
Baseline	0.01	0.867
3 month	0.07	0.243
6 month	0.18	0.004

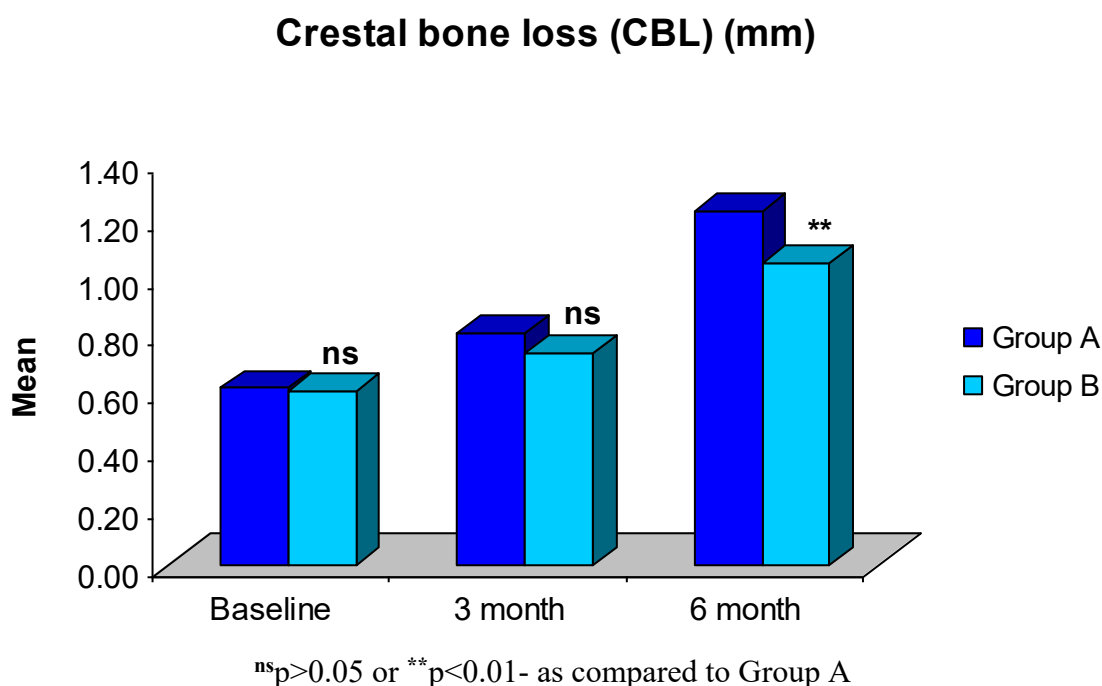


Fig. 18. For each period, comparisons of difference in mean CBL between the groups.

Implant Mobility

No implant mobility was detected in either group throughout the study period, confirming successful osseointegration.

Peri-Implant Probing Depth

PIPD increased in both groups over time; however, the increase was less pronounced in the PRP group, indicating better peri-implant tissue stability.

Crestal Bone Loss

Radiographic analysis revealed significantly greater crestal bone loss in the non-PRP group at 6 months compared to the PRP group ($p < 0.01$), highlighting the positive effect of PRP on peri-implant bone preservation.

DISCUSSION

Conceptual Evolution of Immediate Implant Placement

Dental implantology has progressively shifted from delayed, two-stage protocols toward immediate and early placement concepts in response to patient demand for reduced treatment time and improved esthetic outcomes. Brånemark's original protocol emphasized undisturbed healing to achieve osseointegration; however, subsequent studies demonstrated that osseointegration is not a time-dependent phenomenon alone but a biologically regulated process influenced by local and

systemic factors [1,2]. Immediate implant placement, when executed with adequate primary stability, has been shown to achieve survival rates comparable to delayed protocols [9,10].

Biological Challenges Unique to Immediate Implants

Unlike healed ridges, extraction sockets present a complex biological environment characterized by residual periodontal ligament cells, inflammatory mediators, and socket wall remodeling. The presence of a peri-implant gap and incomplete bone contact may delay secondary stability and compromise early bone formation [11]. Botticelli et al. demonstrated that buccal bone resorption occurs even when implants are placed immediately, underscoring the importance of biologic enhancement strategies to preserve peri-implant bone [11].

Importance of Early Healing Phase

The early healing phase following implant placement is critical, as primary mechanical stability gradually transitions to biologic stability through new bone formation. Any disruption during this phase may lead to fibrous encapsulation rather than true osseointegration [2]. Enhancing early wound healing and angiogenesis may therefore improve implant success, particularly in immediate placement protocols.

Role of Platelet-Rich Plasma in Tissue Regeneration

PRP functions as a reservoir of autologous growth factors that regulate the early stages of wound healing. Marx et al. demonstrated that PRP enhances bone regeneration by increasing cellular proliferation and matrix synthesis [5,7]. Growth factors such as PDGF stimulate chemotaxis and mitogenesis of osteoblasts, while TGF- β promotes collagen production and bone matrix deposition [5]. These effects are particularly relevant in extraction sockets where healing is simultaneous with implant integration.

PRP as a Bioactive Implant Surface Modifier

When PRP is applied to implant surfaces, it forms a fibrin-rich biological coating that modifies the initial implant-tissue interface. Zechner et al. reported increased bone-to-implant contact during early healing following topical PRP application, suggesting accelerated osseointegration [8]. This biofunctionalization may enhance osteoconductivity and promote faster secondary stability, especially in immediate implants.

Implant Survival and Stability Outcomes

In the present study, all implants in both groups demonstrated complete absence of mobility, indicating successful osseointegration. This aligns with resonance frequency analysis studies showing that immediate implants can achieve high primary stability when adequate bone engagement is achieved apically [12]. The findings also corroborate those of Becker et al., who reported sustained implant stability in immediate implants over long-term follow-up [12].

Peri-Implant Soft Tissue Response

Peri-implant mucosal health is essential for long-term implant success. Increased probing depths and bleeding indices are early indicators of peri-implant mucositis [16]. In the present study, PRP-treated implants demonstrated lower MSBI and PIPD values compared to controls. This may be attributed to enhanced fibroblast proliferation, improved vascularization, and faster epithelial sealing promoted by PRP [15,20].

PRP and Inflammatory Modulation

PRP has been shown to modulate inflammatory responses by regulating cytokine expression and promoting balanced tissue remodeling. Reduced bleeding scores in the PRP group may reflect improved vascular integrity and reduced inflammatory infiltrate, as supported by histological

observations in previous studies [8,19]. This anti-inflammatory effect may be particularly beneficial during the early post-operative phase.

Crestal Bone Loss as a Determinant of Success

Crestal bone preservation is a key determinant of implant longevity and esthetic success. Albrektsson et al. proposed that annual bone loss should not exceed 0.2 mm after the first year of function [2]. In the present study, PRP-treated implants demonstrated significantly reduced crestal bone loss at 6 months compared to non-PRP implants. This finding supports the hypothesis that PRP accelerates early bone maturation and stabilizes peri-implant bone levels.

Comparison with Previous Radiographic Studies

Ferrus et al. reported that bone remodeling following immediate implant placement is influenced by socket morphology and buccal bone thickness [13]. The reduced bone loss observed in the PRP group may be due to enhanced osteogenic activity compensating for these anatomical limitations. Similar radiographic outcomes were reported by Georgakopoulos et al., who observed increased bone density around PRP-treated implants during follow-up [19].

Influence of PRP Preparation Protocols

Variability in PRP outcomes across studies may be attributed to differences in preparation methods, platelet concentration, activation techniques, and storage conditions [18]. Sonker et al. emphasized that growth factor release is highly dependent on preparation and handling protocols, which may explain inconsistent findings in the literature [18]. Standardization of PRP preparation remains a critical area for future research.

Short-Term Versus Long-Term Effects of PRP

While PRP appears to significantly enhance early healing and bone formation, several studies suggest that its effects may diminish over time as natural bone remodeling processes dominate [15]. Taschieri et al. reported comparable long-term outcomes between PRP and non-PRP implants, indicating that PRP's primary benefit lies in accelerating early healing rather than altering long-term survival [15].

Clinical Significance in Esthetic Zone

Immediate implant placement in the anterior region demands optimal soft tissue stability and crestal bone preservation. The adjunctive use of PRP may offer a biological advantage in esthetically sensitive areas by promoting faster tissue maturation and reducing early bone loss, thereby enhancing final esthetic outcomes [14,20].

In a study by Iram J et al., 2024 noted a study of 30 patients receiving immediate implants; compared PRF-treated sockets vs controls. Main finding: PRF improved early soft-tissue healing and showed favorable radiographic bone fill around immediate implants [21]. In a study by Bagde HS et al., in 2024 observed PRP adjunct significantly improved bone density and vertical ridge preservation compared with grafts alone [22]. In a study by Zapata-Sifuentes M et al., 2024 [23] noted L-PRP enhanced markers of new bone formation and accelerated early osseointegration in the model. Taghizadeh E et al., 2024 stated [24] Clinical comparisons and narrative synthesis of PRP and PRF used with implants. Main finding: Both PRP and PRF show promise as adjuncts to improve osseointegration and soft tissue healing, but results vary due to preparation differences and study heterogeneity. Rani RP et al., 2024 [25] studied Clinical comparison examining photofunctionalization and platelet concentrates on immediate implant outcomes. New surface treatments (photofunctionalization) and biological adjuncts can both improve early outcomes; combined approaches may be synergistic. Saxena / MedSciMonit / 2024–2025 studied [26] Small clinical trials using injectable PRF (i-PRF) and resonance frequency analysis (RFA) to assess stability after implant placement.

PRF improved RFA values (early stability) in several short-term clinical series. Giannelli A et al., 2025 [[27] observed Overall evidence supports PRP's regenerative potential for both soft and hard tissues, but quality and heterogeneity of trials limit strong long-term recommendations. Jalaluddin M et al., 2025 [28] marked Effect of PRP on peri-implant bone repair (preclinical/clinical synthesis). Multiple lines of evidence show PRP can enhance BIC and local bone density in the early healing period. Umbrella review / MDPI (2025) [29] reviewed compiling systematic reviews on PRP/PRF applications in dentistry.. Strong call for standardized protocols and higher-quality RCTs.

From a patient perspective, PRP use may reduce post-operative discomfort, accelerate healing, and shorten the overall rehabilitation period. As an autologous material, PRP poses minimal risk of immunological reactions and aligns with minimally invasive treatment principles [5,7]. Further randomized controlled trials with larger sample sizes, longer follow-up periods, and histomorphometric evaluations are required to validate the long-term benefits of PRP in immediate implant placement. Future studies should also explore combination therapies involving PRP with biomimetic implant surfaces and bone graft materials.

CONCLUSION

Within the limitations of the present study, it can be concluded that immediate dental implants bioactivated with platelet-rich plasma exhibit improved peri-implant soft tissue response and significantly reduced crestal bone loss compared to non-PRP-treated implants. PRP serves as a valuable autologous biological adjunct in immediate implant therapy.

Declarations:

Conflicts of interest: There is not any conflict of interest associated with this study

Consent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Authors' contributions: Author equally contributed the work

Limitations

- Small sample size
- Short follow-up duration
- Lack of histological evaluation
- Absence of long-term loading assessment

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