

Immediately placed dental implants in smokers with plasma rich in growth factor versus without plasma rich in growth factor: A comparison

ABSTRACT

Introduction: The placement of implants into fresh extraction sockets was introduced in 1970. This approach has been reviewed extensively during the past decade. Immediate postextraction implant placement is a well-accepted protocol. The concept of placement of dental implants soon after the removal of a tooth in smokers, however, is still a matter of controversy.

Purpose: (i) To access failure rate of dental implant in smokers (ii) To evaluate added advantage of plasma rich in growth factors (PRGFs) in immediate placement of dental implants in smokers.

Materials and Methods: The sample of 30 patients was obtained from the different Outpatient Department of Faculty of Dental Sciences; King George's Medical University, Lucknow, who had visited for rehabilitation of missing teeth by implants between April 2013 and July 2015. They were randomly divided into two groups (without use of PRGF and with use of PRGF) of 15 each. Pre- and postoperative assessment included a thorough history and clinical examination, regression of pain and swelling, implant stability by resonance frequency analysis (RFA), and implant stability according to the bone type as well as radiographic interpretation for measurement of bone loss on the mesial and distal surfaces of the implant.

Results: In this study, pain and swelling were significantly ($P < 0.05$) higher in Group A than in Group B across the time interval. RFA score for implant stability was lower in Group A across the period than Group B. At the end of 3 months, RFA score (mean) in Group A was having 72.55 ISQ value, and in Group B, it was 75.71 ISQ value. In this study, postoperative crestal bone loss was more in patients in Group A as compared to patients in Group B. There was significant difference in mesial ($P = 0.003$) and distal ($P = 0.001$) crestal bone loss at 6 months between the groups.

Conclusion: The immediate placement of dental implants in smokers with use of PRGF is shown to be efficient in relation to postoperative pain and swelling, stability, stability according to bone type, as well as bone loss.

Keywords: Dental implant, osseointegration, plasma-rich growth factor, resonance frequency analysis

INTRODUCTION

Rehabilitation of missing teeth is posing a challenge since time immemorial, but with the advent of newer technology in terms of biomaterial, equipment, knowledge, and rehabilitation of missing teeth can be done with predictable outcome up to some extent. The goal of restoration of missing teeth is to restore the normal contour, function, esthetics, and speech regardless of the atrophy of bony and soft tissue, disease or injury of the stomatognathic system.

SHILPI GANGWAR, U. S. PAL, SUNITA SINGH¹, R. K. SINGH, VIBHA SINGH, LAKSHYA KUMAR²


Departments of Oral and Maxillofacial Surgery, ¹Microbiology and ²Prosthodontics and Dental Materials, Faculty of Dental Sciences, King George's Medical University, Lucknow, Uttar Pradesh, India

Address for correspondence: Dr. Lakshya Kumar, Department of Prosthodontics and Dental Materials, King George's Medical University, Lucknow - 226 003, Uttar Pradesh, India. E-mail: lakshya79@yahoo.com

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Ever since the introduction of the concept of osseointegration,^[1] implants have gained significant ground in the field of dentistry. Osseointegration, being the mainstay in implant dentistry, has been the ultimate goal for the dentists to achieve, and one of the prerequisites for this to happen is that the immediate milieu around the dental implant must be conducive for proper healing and tissue regeneration. Failure to achieve osseointegration has been related to several factors such as premature loading, traumatic occlusion, adjacent infection/inflammation, steroid therapy, malnutrition, metabolic diseases, chemotherapy, and radiotherapy.^[2] Two of these risk factors include poor bone quality and smoking.

Conventionally, before placing dental implants, the compromised teeth are removed and the extraction sockets left to heal for several months to 1 year. However, alveolar ridge resorption after tooth extraction can considerably reduce the residual bone volume and compromise the favorable positioning of the implants required for optimal restoration. Following the correct clinical indications, early placement of the implants into the extraction sockets might avoid this undesirable resorption. Hence, the placement of implants into fresh extraction sockets was introduced in the late 1970s. This approach has been reviewed extensively during the past decade. Several reports have presented clinical guidelines for patient selection and/or achieving an optimal outcome with the immediate implant placement procedure.

Added advantages of immediate placement of dental implants are preservation of esthetics, shorter total treatment time, maintenance of socket walls, reduced operative time, and better actual implant placement. The concept of placement of dental implants soon after the removal of a tooth in smokers, however, is a matter of debate.

With regard to smoking, several studies have shown a greater incidence of failure to achieve osseointegration in smokers compared to nonsmokers. Previous studies have been unable to explain why there was an increased failure rate in smokers than nonsmokers. Now medical literature contains numerous publications correlating smoking with less dense bone, assuming smokers have poorer bone quality.

Since smoking has been associated with higher potential failure around implants, to counter this bone grafting – regenerative medicine becomes common requirement either before or after implant placement.^[3] Plasma rich in growth factor (PRGF) has been used to promote the healing, and it has also been added to bone graft to improve the success rates. Animal and human studies have shown that PRGF has certain growth factors which may enhance and accelerate soft-tissue repair

and bone regeneration. A preparation of PRGF applied to an implant, adheres to metal and might create a new dynamic surface that could potentially show biologic activity and help in improving the success rates achieved with dental implants.^[4] However, further long-term studies are still required to validate the results of the few studies that have already been conducted in this regard. Clinical use of this technique in oral implantology could certainly improve the prognosis. The purpose of this study is to evaluate the success of immediate placement of dental implants with PRGF and without PRGF in smoker patients.

MATERIALS AND METHODS

The present study was conducted in the Department of Oral and Maxillofacial Surgery, Faculty of Dental Sciences, KGMU, Lucknow.

Sample selection

This study was initiated in April 2013 and concluded in July 2015. All the patients from the different OPD's of Faculty of Dental Sciences; KGMU, Lucknow, who had visited for rehabilitation of missing teeth by implants were screened for inclusion in the study. Patients were diagnosed and planned on the basis of history and clinical examination as well as radiographic interpretation. Detailed medical history of all the patients was recorded on a set pro forma designed for the study. Routine investigations were also done. Well informed written consent was obtained from each and every patient willing to participate in the study.

Inclusion criteria

1. Patients over the age of 18 years with missing maxillary or mandibular tooth
2. Presence of adequate bone volume to accommodate an implant of appropriate size
3. Patient with good oral hygiene.

Exclusion criteria

1. Pathological change in jaw bone with radiolucency more than 1 cm
2. Chronic inflammatory rheumatoid disease
3. Uncontrolled diabetes
4. Osteoporosis
5. Systemic corticosteroid treatment of more than 1 month within 1 year
6. Severe disease with the life expectancy <1 year.

Study design

A total of 30 implants patients were included in the study. All the patients were randomly divided into two groups of 15 each.

- Group A: Immediate placement of dental implants in smokers without use of PRGF
- Group B: Immediate placement of dental implants in smokers with use of PRGF.

All the implants were placed in the immediate extraction site and were followed by two stage surgery. PRGF was used at the time of first-stage surgery in Group B. Clinical outcome was checked at the baseline and 1, 3, and 6 months interval by radiographic and clinical methods and data were collected.

Equipment used were implant kit, mouth mirror, tweezers, BP handle with blade, periosteal elevator, Howarth elevator, straight elevator, tooth tissue forceps, needle holder, scissors, implant handpiece, physiodispenser.

Preparation of plasma rich in growth factors

Before the surgery and administration of local anesthesia, 8 ml of patients' peripheral blood from the cubital fossa was collected in two autoclaved tubes containing 0.2 ml of 3.2% (0.109 M) Sodium citrate. For centrifugation, centrifugation machine was used in the study. As the centrifuge rotates at 270 G (3500 RPM) for 10 min, the blood components separate out in to:

1. RBCs (red color-bottom half)
2. WBC (A thin white-colored band) and
3. Plasma (Straw colored-top half).

This plasmatic component is divided into four fractions arranged by molecular weight. In ascending order, these fractions are described as:

1. Plasma very rich in growth factors, located in a 0.2 CC layer immediately above the red blood cell line
2. PRGF, located in the following 0.3 CC layer
3. Plasma with growth factors, located in the subsequent 0.5 CC layer
4. Plasma poor in growth factors, located in the most superior 1 CC layer.

These components were separated out in the glass dishes where they remained till further use. The plasma fraction utilized in the growth factor-assisted regenerative technique was restricted to the 1 CC volume located immediately above the red blood cell line of the tube.

Methodology

Surgical implantation

This procedure was performed under local anesthesia (2% Xylocaine hydrochloride with 1:20,000 adrenaline). Once the mucoperiosteal flap reflected, extraction was performed with the help of root forceps, bur, periosteal,

etc., after extraction, the drilling procedure is initiated with the pilot drill which is 2 mm in diameter and length is extended 2 mm beyond the apex of tooth, the sequential drilling was carried out along with internal irrigation. In Group A patients after sequential preparation of osteotomy, implant was inserted in to the osteotomy [Figures 1 and 2] While in Group B, implant was dipped in PRGF before placing it in osteotomy [Figures 3-5]. Hollow inside part of the implant is irrigated and filled with bacitracin ointment, so titanium screw can be easily removed at stage II reentry. Immediately, a resonance frequency analysis (RFA) (Osstell ISQ) reading was taken and then healing screw was placed [Figures 6-8]. Rest of the mucoperiosteal flap is repositioned and sutured to achieve primary tension-free closure.

The patient is discharged after prescribing antibiotic and analgesic and Hexidine mouthwash. The patient was seen after 7 days postoperatively for suture removal.

Follow-up and recall were done at 1, 3, and 6 months postoperatively.

Assessment of the patients

Clinical assessment

1. Pain – Visual analog scale (0–10). The pain measurements were done postoperatively at each follow-up of 1st day; 1, 4, and 12 weeks
2. Swelling – The swelling measurements were done postoperatively at each follow-up of 1st day; 1, 4, and 12 weeks as mild, moderate, and severe
3. Stability – Resonance Frequency Analysis (RFA). The stability measurements were done postoperatively at each follow-up of baseline, 1 month, and 3 months as low (ISQ <60), moderate (ISQ = 60–70), and high (ISQ >70).

Resonance frequency analysis measurement

RFA is a test of the implant-bone complex, in which a transducer applies an extremely small bending force.

A probe emits signals that are repeated by a smart peg or transducer directly screwed onto the implant with a force of 5–10 N-cm. The resonance frequency is calculated from the response signal on an ISQ scale from 0 to 100. The ISQ values were obtained by buccal or palatal measurements with an angulation almost equal to 90°. Primary stability was measured by RFA after implant insertion and at 1, 3, and 6 months.

Radiographic assessment

Assessment of bone for crestal bone loss was done by:

1. IOPAR



Figure 1: Preoperative clinical Group A



Figure 2: After implant placement Group A



Figure 3: Preoperative clinical Group B

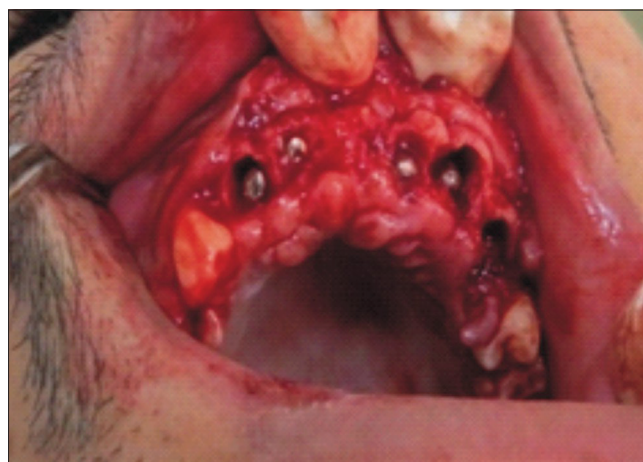


Figure 4: After implant placement Group B

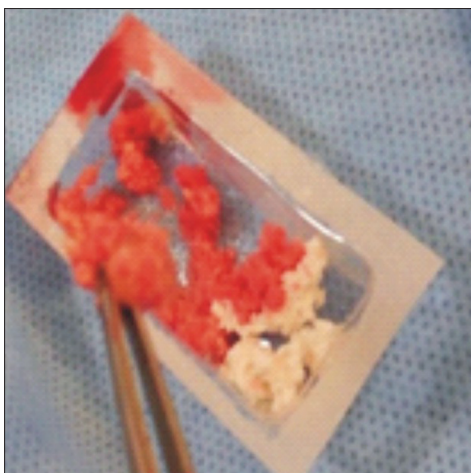


Figure 5: Plasma rich in growth factor mixed with hydroxyapatite graft



Figure 6: Resonance frequency analysis measurement (Group A)

2. OPG
3. Dental computed tomography (Dentascan): At 1 and 3 months interval to assess the evidence of bone loss around the implant.

Crestal bone loss measurement

Assessment of alveolar crestal bone loss was done with the help of intraoral periapical radiograph [Figures 9-12]. XCP extension cone paralleling film-holding device was used as it helps to increase the dimensional accuracy of



Figure 7: Resonance frequency analysis measurement (Group B)



Figure 8: Resonance frequency analysis reading - Group B

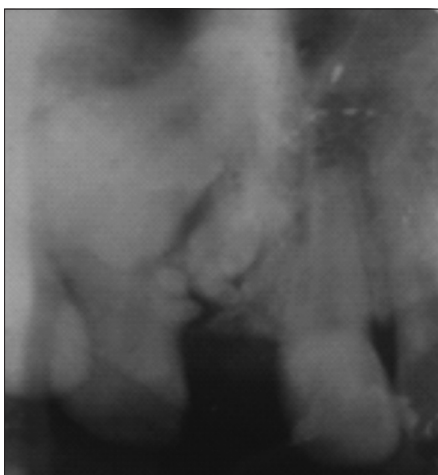


Figure 9: Preoperative radiograph Group A



Figure 10: Postoperative radiograph (Group - A)

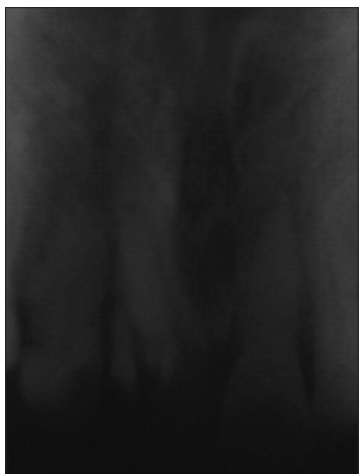


Figure 11: Preoperative radiograph Group B

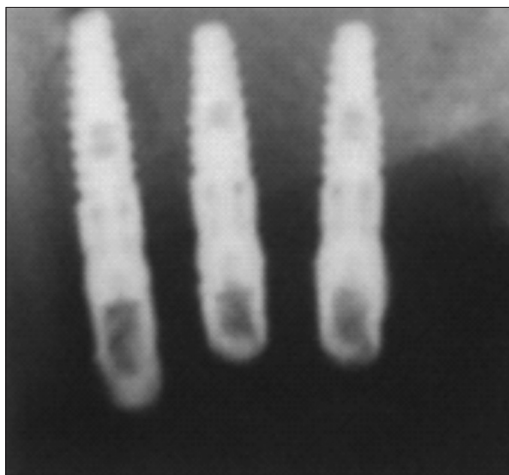


Figure 12: Postoperative radiograph (Group - B)

dental X-ray images. Radiographs were taken at 3 and 6 months interval.

The IOPAR were digitized and analyzed with the help of computer software (DBSWIN 5.6.0, DÜRR Dental, Germany).

The implant-abutment junction was used as a reference point for all measurements. First, the length of implant from implant-abutment interface to the apex of the implant was measured. Then, the distance between observed crestal bone levels and implant abutment interface was measured at the distal and mesial of the implant. The actual crestal bone loss was measured by the following equation.

Actual bone loss =

$$\frac{\text{Actual implant length}}{\text{Measured implant length}} \times \text{Measured bone loss}$$

RESULTS

The present study was carried out at Department of Oral and Maxillofacial Surgery, Faculty of Dental Sciences, KGMU, Lucknow, from the year 2013 to 2015 with an objective to compare the efficacy of PRGF in immediately placed dental implants in smokers. For this purpose, a total of 30 patients were chosen, on the basis of inclusion and exclusion criteria of the study. The patients were randomly divided into Group A and Group B:

- Group A: Immediately placed dental implants in smokers without PRGF
- Group B: Immediately placed dental implants in smokers with PRGF.

Three patients were excluded from the study as they did not come for follow-up visits (2 patients from Group A and 1 patient from Group B).

Following results were obtained

The pain score was significantly ($P < 0.05$) higher in Group A than Group B at day 1 and up to week 1. However, pain was observed to be nil at week 4 and week 12 in both the groups [Table 1].

There was no significant difference in the swelling between the groups at different time intervals [Table 2].

The RFA score was found to be significantly lower in Group A than Group B at 3 months ($P = 0.008$) [Table 3].

There was significant difference in mesial ($P = 0.003$) and distal ($P = 0.001$) crestal bone loss at 6 months between the groups. Bone loss was more on mesial and distal surfaces of implant in Group A in comparison to those in Group B [Table 4].

There was no significant ($P > 0.05$) difference in RFA score among the regions in Group A at baseline, 1 and 3 months [Tables 5 and 6].

DISCUSSION

Smoking has been proven to be detrimental in achieving and maintaining good oral health. The correlation between smoking and periodontal disease, root caries, delayed wound healing, and oral cancers has been documented. In addition, the literature contains reports of decreased ability to achieve osseointegration in smokers compared to nonsmokers;

Table 1: Comparison of pain score between the groups across the time intervals

	Group A (n=13)	Group B (n=14)	P ^a
Day 1	3.89±1.05	2.66±1.04	0.005*
Week 1	1.97±1.05	1.02±0.49	0.006*
Week 4	0.00±0.00	0.00±0.00	NA
Week 12	0.00±0.00	0.00±0.00	NA

*P is less than 0.05. ^aUnpaired t-test, significant

Table 2: Comparison of swelling between the groups across the time interval

	Group A (n=13), n (%)	Group B (n=14), n (%)	P ^a
Day 1			
Mild	3 (23.1)	8 (57.1)	0.07
Moderate	7 (53.8)	6 (42.9)	
Severe	3 (23.1)	0	
Absent	0	0	
Week 1			
Mild	7 (53.8)	6 (42.9)	0.07
Moderate	3 (23.1)	0	
Severe	0	0	
Absent	3 (23.1)	8 (57.1)	
Week 4			
Mild	3 (23.1)	0	NA
Moderate	0	0	
Severe	0	0	
Absent	10 (76.9)	14 (100.0)	
Week 12			
Mild	0	0	NA
Moderate	0	0	
Severe	0	0	
Absent	13 (100.0)	14 (100.0)	

^aChi-square test. NA: Not applicable

Table 3: Comparison of resonance frequency analysis score between the groups across the time intervals

	Group A (n=13)	Group B (n=14)	P ^a
Baseline	63.54±1.41	64.73±1.86	0.07
Month 1	65.28±1.84	67.54±3.82	0.06
Month 3	67.13±2.16	70.85±4.18	0.008*

^aUnpaired t-test, *Significant

however, the reasons for this are not well explained till date. In this study, 30 patients were taken and divided into two groups. No implants were lost throughout the study period. Three patients did not responded on follow-up periods.

The surgical requirements for immediate implants include atraumatic extraction and thorough alveolar curettage to eliminate any possible pathological material. Primary implant stability is also an essential requirement and is achieved either by the extension of implants that exceed the tooth apex by 3–5 mm or by placing a dental implant with a greater diameter than the alveolar socket;^[5] (Barone *et al.* 2006).

Table 4: Comparison of crestal bone loss between the groups across the time intervals

	Group A (n=13)	Group B (n=14)	P ^a
Mesial			
Day 0	1.28±0.44	1.08±0.38	0.20
6 months	1.90±0.43	1.36±0.42	0.003*
Distal			
Day 0	1.60±0.44	1.29±0.40	0.06
6 months	2.14±0.52	1.45±0.45	0.001*

^aUnpaired t-test, *Significant

Table 5: Resonance frequency analysis score according to region in Group A

	Mandible anterior	Maxilla anterior	Mandible posterior	Maxilla posterior	P ^a
Baseline	63.66±1.52	63.62±1.25	64.43±1.25	62.43±1.61	0.42
Month 1	65.00±0.60	65.10±2.76	65.50±1.32	65.60±2.51	0.97
Month 3	67.17±1.52	68.08±2.65	66.33±1.15	66.63±3.27	0.77

^aANOVA test

Table 6: Resonance frequency analysis score according to region in Group B

	Mandible anterior	Maxilla anterior	Mandible posterior	Maxilla posterior	P ^a
Baseline	67.00±1.00	64.96±1.10	64.60±1.51	62.46±0.50	0.42
Month 1	69.97±0.92	69.83±7.18	67.08±1.04	63.60±0.36	0.97
Month 3	74.20±2.58	72.67±7.37	70.36±0.18	66.50±1.32	0.77

^aANOVA test

In this study, pain was significantly ($P < 0.05$) higher in Group A than in Group B across the time interval. However, pain score was observed to be nil at week 4 and week 12 in both the groups. The possible logic seems to be that application of PRGF to implant surfaces gave rise to faster healing of the bone surrounding the implant and enhancement of bone-implant contact (BIC) compared to the control group treatment (PRGF treatment = $59.83\% \pm 3.1\%$, control = $45.67\% \pm 3.7\%$). This is in agreement with the findings of Fontana *et al.*,^[6] Kim *et al.*,^[7] and Fuerst *et al.*^[8] who concluded in their investigation with minipigs that BIC treated with growth factor exhibited a mean value of 55.3%, whereas the mean control BIC was 38.91%. The authors concluded that the application of platelet-derived growth factors could be used to strengthen the anchorage of mandibular implants. Our results were also consistent with the studies of Mozzati *et al.*^[9] and Alissa *et al.*,^[10] they recorded less pain in platelet concentrate-treated sockets at the 7th postoperative day and the 1st, 2nd, and 3rd days, respectively.

In this study, swelling was significantly ($P < 0.05$) higher in Group A than in Group B across the time interval. Then, swelling was observed to be nil in Group A at 4 weeks and as compared to 1 week in Group B. This

reduction of swelling can relate with the study of Mozzati *et al.*^[9] who also concluded less postoperative swelling after impacted tooth extraction in sockets treated with platelet concentrate.

According to this study, the RFA Score for implant stability was lower in Group A across the period than Group B. At the end of 3 months, RFA score (mean) in Group A was having 72.55 ISQ value, and in Group B, it was 75.71 ISQ value. This study correlates with the study of Fuerst *et al.*^[8] who used PRGF with implants with success to increase BIC. While our study did not correlate with the studies of Monov *et al.*,^[11] and Fuerst *et al.*^[8] (2003), in which there was no statistically significant difference between the two groups and concluded that the instillation of platelet-rich plasma (PRP) during implant placement in the lower anterior mandible did not add additional benefit.

According to this study, RFA score for implant stability according to the region of implant placement was obtained to be higher (at the end of 3 months) for Group B in mandibular anterior region followed by maxillary anterior than mandibular posterior, and maxillary posterior region as compared to Group A. Our study also correlates with the study of Lekholm and Zarb (1985) which also reveal higher stability values for the mandibular implants in comparison with the maxillary ones. This may be explained by the good bone quality observed in the mandible (Type 1/2). The quantity and location of cortical and trabecular bone surrounding the implants are important factors for stability because these factors contribute to bone-implant contact.^[12] A significant relationship was found between the bone type and ISQ values.^[13-18] A strong correlation between bone density and ISQ values in the present study are consistent with a previous study by Turkyilmaz *et al.* (2007) who concluded that the successful outcome of any implant procedure depends on a series of patient-related and procedure-dependent parameters, including general health conditions, biocompatibility of the implant material, the feature of the implant surface, the surgical procedure, and the quality and quantity of the local bone. The healing process will be affected by bone morphology, including its trabecular pattern, density, and the degree of mineralization.^[19] (2005). Implant stability is a prerequisite for the long-term clinical success of implant-supported restorations and depends on the quantity and quality of the local bone, the implant geometry, and the surgical technique used (subinstrumentation vs. overinstrumentation).^[18,20]

In our study, postoperative crestal bone loss was more in patients in Group A (mesial-immediate postoperative 1.28;

6-month postoperative 1.90; distal-immediate postoperative 1.60; 6-month postoperative 2.14) as compared to patients in Group B (mesial-immediate postoperative 1.08; 6-month postoperative 1.36; distal-immediate postoperative 1.29; 6-month postoperative 1.45). There was significant difference in mesial ($P = 0.003$) and distal ($P = 0.001$) crestal bone loss at 6 months between the groups.

The results were also consistent with the studies of Fontana *et al.*^[6] found a higher amount of peri-implant bone volume after inserting PRP and laminar test implants into rat tibial sites. Our study also correlates with the study of Nikolidakis *et al.*^[21] who concluded that the additional use of PRP did not have any effect on the early cortical bone response to the Ca-P-coated implants, whereas PRP in a liquid form showed a tendency to increase bone apposition to roughened titanium implants. Our study also correlates with the study of Ortolani *et al.*^[22] The results from this study demonstrate that rabbits treated with the combination PDGF/IGF-1 showed a higher positive effect on bone regeneration than PRP-treated or controls. Our study correlates with the study of Zechner *et al.*^[23] (2003) who also advocated the benefits of topical application of implants before insertion and saw effects in early healing.

The survival rate of dental implants in the present study was 90%, which was correlated with the study of Penarrocha *et al.* 2004, in which immediate implants positioned in the course of tooth extraction exhibit a success ranging from 92.7% to 98%. Dental implants placed in fresh extraction sockets presented several advantages, such as reductions in surgical trauma and the treatment time.

CONCLUSION

Results of both the groups of immediate placement of implants in smokers seem to be quite effective. The following conclusion can be drawn from this study:

1. There was faster recovery from postoperative pain in Group B as compared to Group A
2. Group B exhibited less postoperative swelling at implant site and less inflammation as compared to Group A
3. There was lesser postoperative crestal bone loss on mesial and distal surfaces of implants in Group B when compared to Group A
4. ISQ value of RFA was initially same for both the groups (i.e., primary stability) but raised significantly during 2–4 weeks due to early osseointegration in Group B, which then remained stable after 3 months
5. ISQ value of RFA was more for the implants placed in the mandibular anterior region followed by maxillary anterior region and then of mandibular posterior and maxillary

posterior region in Group B as compared to Group A but the variation according to the region was same.

Based on the present literature review, it was concluded that the smoking habit may represent an additional risk factor for implant therapy; however, cigarette smoking should not be an absolute contraindication for this treatment. Osseointegration was enhanced by covering the implant surface with PRGF before insertion into the alveolus. The clinical use of this biologically active surface in oral implantology might improve the prognosis, but long-term randomized controlled clinical studies are needed to validate the findings of this study.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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