Original Article - Comparative Study

Direct Maxillary Sinus Floor Augmentation for Simultaneous Dental Implant Placement

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Abstract

Aim: The present study was done to evaluate the efficacy of platelet-rich fibrin (PRF) with bovine bone graft (Bio-Oss™) in direct sinus augmentation for simultaneously dental implant placement. **Materials and Methods:** The study included 14 patients who fulfill the inclusion criteria, among them 10 were male and 4 were female with PRF with Bio-Oss™. For each patient, bone level was assessed preoperatively and postoperatively after 1, 6, and 12 months with a panoramic X-ray and radiovisiography to evaluate the vertical bone height from the shoulder of the implant to the most apical end. **Results:** The outcome of the sinus lift and the implants placed was evaluated periodically at 1, 6, and 12 months postoperatively. All the patients underwent two-stage procedures. At the end of 20th week, implants were exposed; radiological parameters were assessed again for implant integration, and prosthetic rehabilitation was started after 2 weeks and it was completed by the end of 24 weeks (6 months postoperatively). Twelve months postoperatively, the endosinus bone gain noted was 7 mm, which indicated the use of PRF with bovine bone graft as a reliable filling material during simultaneous sinus lift and implantation. **Conclusion:** PRF with bone graft (Bio-Oss) is used as an augmentation material after direct maxillary sinus lift, and the resulting bone formation was adequate for placement of dental implant.

Keywords: Bone graft (Bio-Oss™), dental implant, direct sinus augmentation, platelet-rich fibrin

Introduction

Nowadays, the use of dental implants for oral rehabilitation has become a clinical routine. Several studies have reported successful and predictable results in patients with normal bone volume and density, which provide adequate stabilization for implants of standard diameter and length.[1] The loss of teeth in the posterior upper jaw is the main cause for patients requiring dental implant. There are two main reasons which make the rehabilitation of posterior maxilla difficult. First, after loss of teeth in the posterior maxilla, the alveolar ridge decreases by bone atrophy and resorbs vertically and horizontally.[2,3] Second, pneumatization of maxillary sinus causes insufficient vertical bone volume on posterior maxilla.[4] Hence, the restoration of edentulous posterior maxilla with dental implants is challenging due to a deficient posterior alveolar ridge. Grafting the floor of the maxillary sinus is a method of attaining sufficient bone height for posterior maxilla implant placement and has proven to be a highly successful and predictable technique to overcome this problem. The "sinus lift" procedure with bone grafting was reported by Tatum in 1975 and published for the first time by Boyne and James in 1980.[4] Among the variety of sinus floor elevation techniques described in the literature, two approaches, the crestal approach and the lateral window approach, have been mostly used.[5] Various types of grafting material have been successfully utilized for sinus augmentation. Autogenous bone, xenogenic bone, or a mixture of material may be used for sinus augmentation. However, these grafting materials have a high success rate, but they have their associated disadvantage of second site surgery or the cost factor.[6] To overcome these problems, platelet-derived preparations which are rich in growth factors may contribute to an accelerated tissue regeneration

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process. The therapeutic osteogenic effect of local platelet administration probably depends on the amount of growth factors delivered within.[6,7]

Platelet-rich fibrin (PRF) is an autologous fibrin matrix that belongs to a new generation of platelet concentrates, with simplified processing and without biochemical blood handling. PRF has numerous growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor (TGF), and insulin-like growth factor (IGF). These growth factors accelerate early bone regeneration by increased angiogenesis, chemotaxis, mitosis, stem cell proliferation, wound healing, bone growth and maturation, wound healing, and hemostasis. The use of PRF to accelerate the process of osseointegration is a recent technique in implantology.[7]

The purpose of this study was to evaluate the efficacy of PRF with bovine bone graft (Bio-Oss™) in direct sinus augmentation for simultaneously dental implant placement and the specific aims of the study were to measure the variables such as intraoperative (integrity of sinus membrane and bleeding) and postoperative (sinus complaints and radiographic assessment of bone level).

Aim

The present study is being undertaken to evaluate the efficacy of PRF with bovine bone graft (Bio-Oss™) in direct sinus augmentation for simultaneously dental implant placement.

Materials and Methods

The present study was conducted on 14 patients who were selected from the Outpatient Department of Oral and Maxillofacial Surgery, HIDS, Paonta Sahib (Himachal Pradesh) between 2014 and 2016. Of 14 patients, 10 were male and 4 were female**.** Inclusion criteria are as follows: (1) posterior edentulous maxilla with available vertical bone 3–5 mm, (2) age between 18 and 65 years, (3) ASA type 1 and 2 patients, and (4) adequate quality of native bone to achieve primary stability. Exclusion criteria are as follows: (1) patient who were chronic smokers, (2) acute maxillary sinusitis, (3) any condition, diseases, or medication that might compromise healing or osseointegration, (4) any cyst/tumor, and (5) patients who were treated with radiation therapy and severe bruxism.

Methods

Each case was precisely evaluated clinically and radiographically, and a detailed medical history with written consent was taken. All the patients were advised preoperative oral prophylaxis and prophylactic antibiotics with the standard dosage of tablet ornidazole 500 mg and augmentin 625 mg, 12 h before surgery. Local anesthesia (lignocaine 2% with adrenaline [1:200,000]) was administered. A mucoperiosteal flap was elevated, and window was prepared on the lateral sinus wall for surgical access with a diamond round bur. The membrane was elevated from the antral floor, medial, anterior, and posterior wall, with curettes [Figures 1-4]. Thereafter, freshly prepared autologous PRF with bone graft (Bio-Oss™) was placed in the antral floor under the previously elevated sinus membrane to a level appropriate for implant insertion. A titanium implant of proper length and diameter was inserted and primary closure was done [Figures 5 and 6]. An intraoral periapical radiograph (IOPA) was taken for the evaluation of appropriate implant placement. Pharmacologic protocol was followed postsurgically. Regular follow-up was done and standardized intraoral radiographs (RVG Kodak Software 5100, Carestream Health, Inc., Rochester, NY) and CS 8100 Carestream (OPG), 1.2 (+_ 10%) were taken immediately after surgery and at 1 month, 6 months (prosthetic phase), and 12 months postoperatively.

Clinical and radiographic parameters

Intraoperative

1. Integrity of the Schneiderian membrane: assessed visually, with irrigation and Valsalva maneuver
2. Any intraoperative complications such as bleeding/perforation or any limitations in the sinus lift elevation were assessed.

Postoperative

1. Sinus complaints (discomfort, nasal congestion, and blocked nose) at the end of 1 week, 1 month, and 3 months
2. Oroantral fistula at the end of 1 week, 1 month, and 3 months
3. Premature exposure of implant at the end of 1 week, 1 month, and 3 months
4. Bone level was assessed radiographically preoperatively and postoperatively at 1 month, 6 months (prosthetic phase), and 12 months. RVG (Kodak software) and OPG were taken, and the bone levels were measured, from the shoulder of the implant to the most apical end.

Radiographic evaluation

- Standardized IOPAs, RVG (Kodak software), and OPG were taken during preoperative assessment, immediately after surgery and postoperatively at a follow-up of 1 month at prosthetic phase (5–6 months) and after 1 year of implant placement
- Long-cone paralleling technique was used to take IOPAs
- Implant neck was considered as the reference point for each measurement
- Changes in the vertical bone height were calculated.

Results

A prospective clinical study was conducted on 4 female and 10 male patients who underwent direct sinus augmentation procedure using Choukroun's PRF graft material plus bone graft. Minimum residual bone height of the patients was 3 mm. Fourteen direct sinus lift procedures (elevation of the sinus floor membrane) were performed in the maxillary molar region and the premolar region.

The parameters assessed intraoperatively included the integrity of the membrane and other complications such as bleeding or limitations to achieve sinus lift.

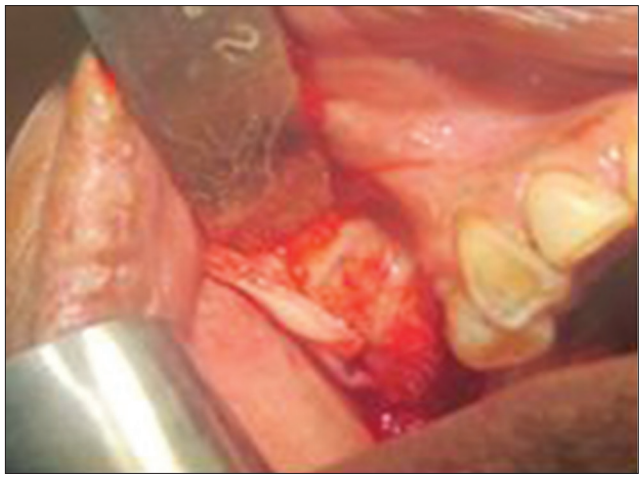

Figure 1: Incision and reflection

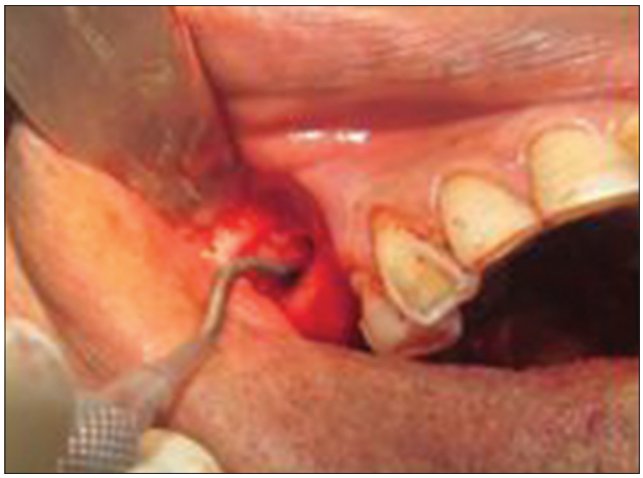

Figure 2: Elevation of sinus membrane with curette

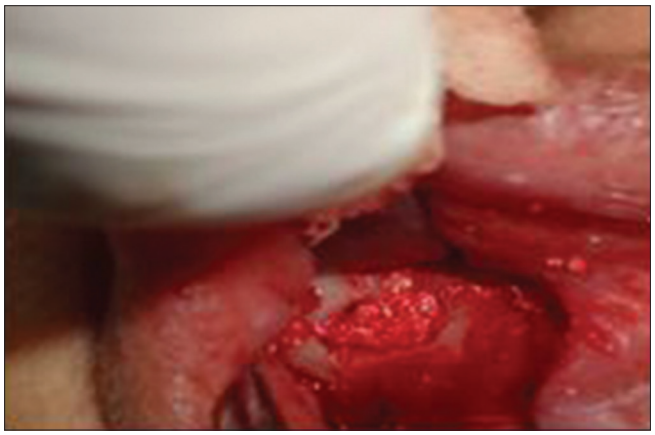

Figure 3: Bone graft with platelet-rich fibrin

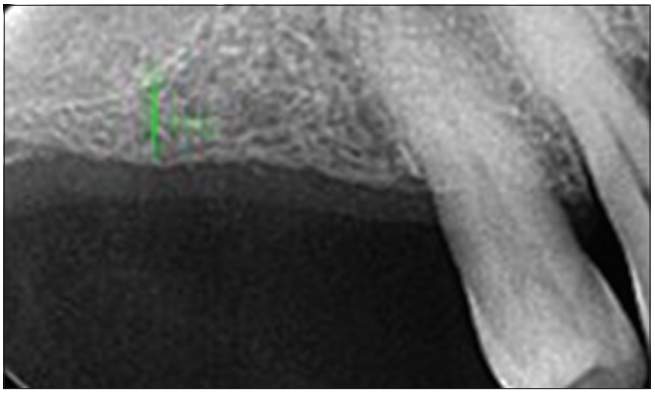

Figure 4: Preoperative RVG

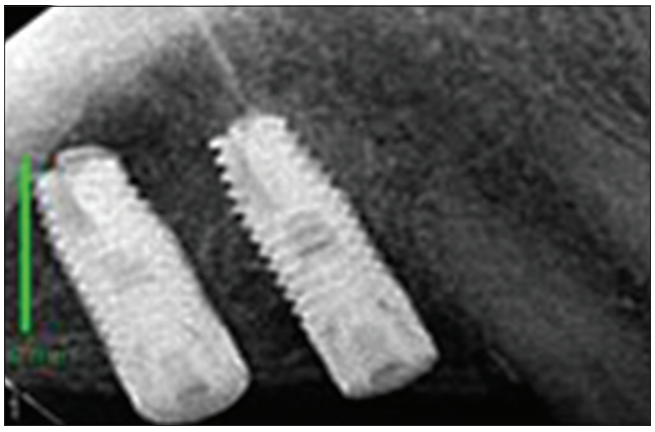

Figure 5: Immediate postoperative RVG

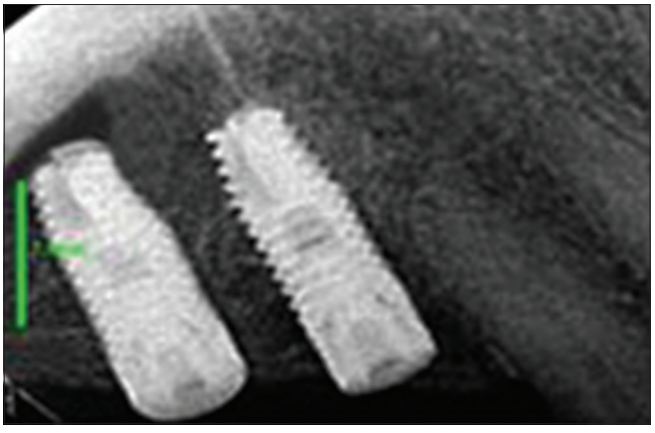

Figure 6: Postoperative RVG after 12 months

The parameters assessed in the postoperative period included sinus complaints (congestion and blocked nose), oroantral fistula, premature exposure of implant, and bone level (from neck of implant to the elevated sinus floor was assessed radiographically) at 1 month, 6 months, and 12 months after implant placement.

Intraoperative parameter

A total of 14 cases of sinus floor elevation were done; in 13 patients, no perforation of sinus membrane was noticed intraoperatively, except in 1 case, indicating 93% membrane integrity which was assessed with irrigation and Valsalva maneuver.

Postoperative parameters

There was no postoperative complications such as sinus

complaints and oroantral fistula and premature exposure of implants after 1 week, 1 month, and 3 months.

The outcome of the sinus lift and the implants placed was evaluated periodically at 1 month, 6 months, and 12 months postoperatively. All the patients underwent two-stage procedures. At the end of 20th week, implants were exposed; radiological parameters were assessed again for implant integration and prosthetic rehabilitation was started after 2 weeks and it was completed by the end of 24 weeks (6 months postoperatively). Twelve months postoperatively, the endosinus bone gain noted was 7 mm, which indicated the use of PRF with bovine bone graft as a reliable filling material during simultaneous sinus lift and implantation [Tables 1 and 2].

Discussion

The present study was undertaken with the aim to evaluate the efficacy of PRF with bovine bone graft (BIO-OSS™) in direct sinus augmentation for simultaneously dental implant placement. Various techniques are discussed broadly for maxillary sinus lift with PRF and bone graft.[8-10] Choukroun's PRF is a simple and inexpensive technique that can be used currently in daily practice. This technique is the simplest and cheapest way to produce autologous fibrin membrane or platelet concentrate. The systemic use of this biomaterial during sinus lift with or without bone grafts seems a very interesting option, particularly for protection of the Schneiderian membrane.[11-13]

PRF has numerous growth factors, such as PDGF, TGF, and IGF.[13-16] PRF and bovine bone graft material combination may be another treatment choice to the frequently used bovine bone graft material and collagen membrane combination. PRF is effective, in particular, in the first stages of wound healing, and its efficacy may change depending on the characteristics of jointly applied graft material.[17] The sinus cavity shows a high osteogenic potential and is a very strong model of an osteogenic chamber for bone regeneration. It offers several advantages which include promoting wound healing, bone growth and maturation, wound healing, and hemostasis.[16,17]

The overall success of implant can be determined using the radiographic parameter. The radiographic parameter includes assessment of vertical bone height.[18] Hence, the present study is undertaken to evaluate the efficacy of PRF with bovine bone graft (Bio-Oss™) in direct sinus lift procedure. In our study, there is no perforation of sinus membrane/bleeding was noticed intraoperatively, except 1 case of 14 patients, indicating 93% membrane integrity which was assessed with irrigation and Valsalva maneuver. The result of our study was consistent with the study done by Mazor *et al*.[18] In their case series, 25 sinus elevations were performed on 20 patients who fulfilled the inclusion criteria and were treated with 41 implants. No clear sinus membrane perforation was observed, probably due to the soft sinus lift procedure with an ultrasonic lancet. After surgery, healing was uneventful for all patients. Six months after surgery, all implants were clinically stable during abutment tightening. According to this study, the result is significant.

Table 1: Comparison of bone levels assessed radiographically from neck to elevated sinus floor membrane at 1 month, 6 months, and 12 months

Preoperative bone level (mm)	Postoperative bone level (mm) 1 month	Postoperative bone level (mm) 6 months	Postoperative bone level (mm) 12 months
4	12	11.5	11.5
6	13	12.6	12
5	11	10.5	10.5
5	14	13.6	12.5
3	12	12	11.5
5	12	11.8	11.8
6	14	13	13
5	12	11.8	11.5
6	12	11.5	11.5
7	13	12.8	12.5
3	13	12	11
3	11	10.5	10
5	15	14.7	14
4	11	10.5	10

Table 2: Repeated measures ANOVA

	Mean	SD	*n*	*F*	*P*
Preoperative	4.7857	1.25137	14	150.96	<0.001
Postoperatively after 1 month	12.5000	1.22474	14		
Postoperatively after 6 months	12.0143	1.20311	14		
Postoperatively after 12 months	11.6643	1.11673	14		

SD=Standard deviation

Recent studies have shown good results of the use of the PRF in stimulating bone regeneration, but according to Mazor *et al*.[18] and Diss *et al*.,[19] in direct sinus lift with lateral window technique, early postoperative panoramic radiographs (8–10 days after surgery) showed implants inserted in the sinus cavity without dense tissue around them, with PRF filling being radiotransparent. However, 6 months after the sinus lift, the sinus cavity around the implants was filled with a dense bone-like tissue. Radiographic analysis showed that the final bone gain was always very significant. With these long implants, bone gain was between 7 and 13 mm. In their technique, implants were used as tent pegs to define the required bone volume, and the implant shape did not seem to influence the position of the new sinus floor, and in Diss *et al*.'s[19] study sinus lift with BAOSFE Technique (bone added osteotome sinus floor elevation), PRF act as a graft material. In their study, bone gain was 5.8 and 5.2 on mesial and distal side of the implant as compared to both studies; the study result is almost significant.

In our study, the outcome of the sinus lift with placement of PRF with bone graft and the implant placement was evaluated periodically at 1 month, 6 months, and 12 months postoperatively. Twelve months postoperatively, the endosinus bone gain of 7 mm was noted, which suggested that the use of PRF plus bone graft is a reliable filling material after sinus elevation with immediate implant placement as it promotes bone formation. Thus, the use of PRF along with bone graft resulted in high amount of bone around the implants: indeed, in this case series, the follow-up showed that periimplant bone finally stabilized up to the implant end. Finally, this study was performed with direct sinus lift with lateral window technique and PRF with bovine bone graft (Bio-Oss™) acts as a reliable and effective grafting material for sinus lift procedure.

Conclusion

In the present study, PRF with bone graft (Bio-Oss™) is used as an augmentation material after direct maxillary sinus lift, and the resulting bone formation was adequate and effective for placement of dental implant.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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