Efficacy of Platelet Rich Plasma in Sinus Lift Augmentation

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Abstract The present study aims to evaluate and analyze the efficacy of Platelet Rich Plasma (PRP) with hydroxyapatite crystals for maxillary sinus augmentation procedures. A comparative study of 10 patients with a mean average age of 35 years with less than 5 mm of residual alveolar bone was conducted. Six patients underwent Lateral sinus lift procedure with allografts (platelet rich plasma and hydroxyapatite crystals) and four patients underwent the same procedure but with autografts (symphyseal). Follow-up for a period of 3 years was done. The patients were assessed for postoperative pain, sinusitis, oro-antral communication, epistaxis, graft rejection, infection and potential loss of bone and teeth. During the 3 years period of follow-up there were no complications recorded. A mean post-operative augmented height of 15 mm was achieved in all the patients. Maxillary sinus lift procedure using a mixture of hydroxyapatite crystals and platelet rich plasma was found to be very effective in increasing the height of residual alveolar bone when compared to the use of autografts alone.

Keywords Maxillary sinus lift augmentation · Autografts · Platelet rich plasma · Hydroxyapatite crystals

Introduction

Patients with edentulous posterior maxillae often present with loss of alveolar bone and increased maxillary sinus pneumatization. As a result, dental restoration is often difficult to achieve due to inadequate bone volume, to support the placement of endosseous dental implants and prosthetic restoration.

Maxillary sinus floor augmentation surgical procedure is meant to increase alveolar bone height by the formation of new bone in the lower portion of the maxillary sinus.

Platelet rich plasma is an autologous source of concentrated platelets obtained by sequestering and concentrating platelets by gradient density centrifugation [1, 2].

Platelet rich plasma when combined with thrombin and calcium chloride, leads to the release of platelet-derived growth factors (PDGF) and transforming growth factors. PDGF is a glycoprotein, which has mitogenic, angiogenic and macrophage activation properties. Transforming growth factor (TGF- β) is a protein that stimulates chemotaxis and mitogenesis of osteoblast precursors, promotes differentiation toward mature osteoblasts, stimulates deposition of collagen matrix and inhibits osteoclast formation and bone resorption.

This study demonstrates the use of sinus lift procedure as a definite reliable method for increasing the height of alveolar bone above and below the alveolus prior to implant insertion as a preprosthetic adjunct.

Materials and Methods

The study was conducted at our department after obtaining approval from the ethical committee. Ten patients (eight

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Fig. 1 Pre-operative orthopantomograph

male and two female patients with a mean age of 35 years) with a need for fixed replacement of missing posterior upper teeth reported to the department OPD from 2003 to 2006 were included in the study. All the patients were subjected to a routine clinical and radiological examination.

Inclusion criteria:

1. Age—between 25 and 50 years.
2. Absence of any infection in the maxillary sinus, systemic diseases, oral habits, allergy or hypersensitivity to local anaesthetics.
3. Platelet count within normal range.
4. Mean residual alveolar height of 4–5 mm measured by orthopantomogram.

Examination of the posterior maxilla was done by palpation and panoramic radiographs (Fig. 1). Pre-operatively bone mapping was done for all the patients.

Bone Mapping

Under topical anaesthesia, using a reamer; the buccal, palatal and residual alveolar ridge bone height measured from the gingiva to the alveolar bone. The stoppers were marked, the height measured in millimeters. Pre-operatively all the patients were subjected to antibiotic therapy. One hour before the proposed procedure all the patients were asked to rinse with chlorhexidine mouth wash. The surgery was done as a day care procedure.

Preparation of Platelet Rich Plasma

One hour before the proposed surgical procedure patients were taken to the blood bank, 5 ml of their blood was collected in sterile test tube (Fig. 2); it was centrifuged at around 2500–4500 rpm (Fig. 3) [2]. Platelet poor plasma

Fig. 2 5 ml of autologous blood

Fig. 3 Centrifuge

Fig. 4 Centrifugation process

and platelet rich plasma were obtained. Then they were again centrifuged at around 1500–2500 rpm (Fig. 4), PRP alone was collected in a separate test tube (Fig. 5). Human bovine thrombin and 10% calcium chloride were also prepared (Fig. 6). During the surgical procedure all the four components namely the platelet rich plasma, human bovine thrombin, calcium chloride and plasma were mixed in equal proportions (Fig. 7).

Fig. 5 Collected PRP

Fig. 8 Crevicular incision placed

Fig. 6 Platelet rich plasma, human bovine thrombin, calcium chloride and plasma

Fig. 9 Mucoperiosteal flap reflected

Fig. 7 Four components were mixed in equal proportions

Bone Grafts

In four patients we used symphyseal bone as (autograft) the graft material. Hydroxyapatite crystals (allograft) were used as the graft material in the other six patients.

Fig. 10 Lateral window made

Surgical Procedure

Unilateral sinus grafting was done for all the cases using lateral window approach (Figs. 8, 9). Sinus membrane was carefully elevated from the sinus floor and the lower one-

Fig. 11 Hydroxyapatite crystals with PRP gel packed into the cavity

Fig. 12 Wound closure

Fig. 13 Post-operative OPG

half of the medial, anterior, and posterior sinus walls (Fig. 10). Once the sinus membrane had been elevated, the mixture of hydroxyapatite crystals with PRP gel [3] was packed into the cavity (Figs. 11, 12). Patients were

Fig. 14 Pre-operative and post-operative OPGs compared

reviewed after a week, 2 months, 6 months, 1 year and 3 years, respectively (Figs. 13, 14).

Results

Clinical performance in both cases (auto and allografts) were assessed. Densitometric values were higher in PRP with allograft. Histologically bone growth activities were seen at the PRP sites, but the activity was observed to reduce with longterm intervals above 6 months.

Discussion

Bone availability is the key for successful placement of endosseous implants in the posterior maxilla. When the thickness of bone between the sinus and alveolar crest is less than 10 mm, increasing the thickness of the sinus floor is advantageous to provide sufficient support to allow placement of implants greater than 8 mm long and prosthetic restoration. Creating maxillary bone for the placement of implants relies on onlay grafts [4, 5], interpositional (Le Fort I) grafts, or inlay grafts which include the nasal floor and sinus grafting. Bone can be formed in the sinus floor by intruding teeth and stress stimulation on the alveolar ridge in the sinus. Elevation of

the sinus membrane also results in bone formation of the sinus floor [6]. The amount of bone that can be created by these methods, however, is not sufficient for creating the

a period of 3 years. Post-operative complications were not reported.

Results

Case no.	Age/ sex	Bonegraft	Available bone	Assessment of maxillary bone ^a	Bone mapping	Pre-op residual alveolar ridge (mm)	Post-op residual alveolar ridge (mm)
Case I	45/M	Allograft	Class-D	Class-V	2.5, 2.0 and 1.5	5	22
Case II	35/M	Autograft	Class-D	Class-V	2.5, 2.0 and 1.0	5	12
Case III	35/M	Allograft	Class-D	Class-V	2.0, 1.8 and 1.0	4	22
Case IV	34/F	Allograft	Class-D	Class-V	3.0, 2.5 and 2.0	5	20
Case V	48/M	Allograft	Class-D	Class-V	2.8, 2.0 and 1.5	4	20
Case VI	36/F	Autograft	Class-D	Class-V	2.2, 1.8 and 1.5	4	12
Case VII	32/M	Autograft	Class-D	Class-V	2.8, 2.0 and 2.0	5	10
Case VIII	39/M	Allograft	Class-D	Class-V	2.6, 2.4 and 1.8	5	24
Case IX	28/M	Autograft	Class-D	Class-V	2.3, 1.4 and 1.6	4	12
Case X	42/M	Allograft	Class-D	Class-V	3.0, 2.5 and 2.4	6	28

^a According to Cawood and Howell classification of residual alveolar bone height

10–15 mm of bone necessary for implant stabilization [7]. Van Den Bergh et al. (2000) in his study concluded that osteogenic protein-1 has the potential for initiating bone formation in maxillary sinus, so can be used instead of the gold standard autogenous bone [8]. Wheele et al. (1997) in his study concluded that alloplastic material in sinus augmentation reduces the morbidity and expenses of the procedure. Therefore, the need to develop an allograft, alloplast, or xenograft substitute is widely recognized [9]. We have used hydroxyapatite crystals as the choice of graft material, because of its ease of availability, ease of handling and cost effectiveness.

PRP has the potential to increase the rate of bone formation in a graft and to enhance the density of bone volume [10]. PRP with freeze dried bone allograft for alveolar ridge augmentation, maxillary sinus lift and guided bone regeneration has been used by various authors in the literature [9, 11]. When hydroxyapatite and PRP were mixed together, the hydroxyapatite crystals get engaged in the PRP gel, so the resultant mix becomes thicker and easily adaptable into the defect. Mostly sinus lift procedures are been performed under general anaesthesia, but in our study we have done under local anaesthesia as a day care procedure, in order to reduce the morbidity and for cost effectiveness. In order to achieve quantitative and qualitative bone graft we have used hydroxyapatite crystals with platelet rich plasma for sinus augmentation procedure [12]. Post-operative residual alveolar ridge measurement was evaluated using orthopantomograph [13], the amount of bone formation was monitored at intervals of 6 months for

Conclusion

On analyzing and evaluating the ten cases of maxillary sinus lift procedure where allograft and PRP were used in six cases and autograft alone was used in four cases, the following conclusions were made.

When autografts alone was used, the resorption rate was high hence the eventual residual alveolar bone height achieved after the grafting was lesser comparatively.

When hydroxyapatite alone is used as a graft material, there are chances of the graft getting dislodged but when mixed with PRP gel, graft dislodgement can be prevented. As these graft materials are pre-sterilized, the incidence of infection was considerably less when compared to other grafts. Our study demonstrates the use of maxillary sinus lift procedure using a mixture of hydroxyapatite and platelet rich plasma as a definite reliable method for increasing the height of alveolar bone above and below the alveolus prior to implant insertion and as a preprosthetic adjunct when compared to autografts alone.

References

1. Dugrillon A, Eichler H, Kern S, Kluter H (2002) Autologous concentrated platelet rich plasma (CPRP) for local application in bone regeneration. *Int J Oral Maxillofac Surg* 31:615–619
2. Choi BH, Jim C (2004) Effect of platelet-rich-plasma on bone regeneration in autogenous bone graft. *Int J Oral Maxillofac Surg* 33:56–68
3. Choi BH, Zhu S-J, Kim BY, Hoh J-Y, Lee S-H, Jung J-H (2005) Effect of platelet-rich-plasma (PRP) concentration on the

- viability and proliferation of alveolar bone cells: an in vitro study. *Int J Oral Maxillofac Surg* 34:420–425
4. Chol BH, Jim C, Huh JJ, Sum JJ, Lee SH (2004) Effect of platelet-rich-plasma on bone regeneration in autogenous bone graft: regeneration in autogenous bone graft. *Int J Oral Maxillofac Surg* 33:56–59
 5. Raghoobar GM, Brouwer THJ, Reintsema H, Van Oort RP (1993) Augmentation of the maxillary sinus floor with autogenous bone for the placement of endosseous implants. *J Oral Maxillofac Surg* 51:1198–1203
 6. Block MS, Kent JN (1993) Maxillary sinus grafting for totally and partially edentulous patients. *J Am Dent Assoc* 124:139–142
 7. Jensen J, Sindet-Pederson S, Oliver AJ (1994) Varying treatment strategies for reconstruction of maxillary atrophy with implants. *J Oral Maxillofac Surg* 52:210–216
 8. Butterfield KJ, Bennett J (2005) Effect of platelet-rich-plasma with autogenous bone graft for maxillary sinus augmentation in a rabbit model. *J Oral Maxillofac Surg* 63:370–376
 9. Politi M, Francesco, Costa F, Robiony M (2003) Bone biological box (BBB): an evolution of the sinus graft. *J Oral Maxillofac Surg* 61:1108–1112
 10. Kim S-G, Kim W-K, Park J-C, Kim H-J (2002) A comparative study of osseointegration of avana implants in a demineralised freeze-dried bone alone or with platelet-rich-plasma. *J Oral Maxillofac Surg* 60:1018–1025
 11. Neyt LF, Calix, Abeloos JUS, Mommaerts MY (1997) Reconstruction of the severely resorbed maxilla with a combination of sinus augmentation, onlay bone grafting, and implants. *J Oral Maxillofac Surg* 55:1397–1401
 12. Kanno T, Taabashi T, Tsojigawa T et al (2005) Platelet-rich-plasma enhances human osteoblast-like cell proliferation and differentiation. *J Oral Maxillofac Surg* 63:362–369
 13. Peleg M, Chaushu G, Mazor Z, Ardekian L, Bakoon M (1999) Radiological findings of the post-sinus lift maxillary sinus: a computerised tomography follow-up. *J Periodontol* 70:1564–1573
 14. Kassolis JD, Rosen PS, Reynolds MA (2000) Alveolar ridge and sinus augmentation utilizing platelet-rich-plasma in combination with freeze-dried bone allograft. *J Periodontol* 71:1654–1661