A-PRF in Maxillary Sinus Augmentation for Dental Implant - A Case Report

C Burnice Nalina Kumari1*, Pradeep Devadoss2, Vijayalakshmi R3, M Sujeetha4, Jaideep Mahendra5 and Aazam Ahamed Puthan Purakkal6

1Senior Lecturer, Department of Periodontology, Faculty of Dentistry, Meenakshi Academy of Higher Education and Research, Chennai, India
2Reader, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Meenakshi Academy of Higher Education and Research, Chennai, India
3Reader, Department of Periodontology, Faculty of Dentistry, Meenakshi Academy of Higher Education and Research, Chennai, India
4Department of Periodontology, Faculty of Dentistry, Meenakshi Academy of Higher Education and Research, Chennai, India
5Director of Post graduate Studies, Professor, Department of Periodontology, Faculty of Dentistry, Meenakshi Academy of Higher Education and Research, Chennai, India
6Puthan Parakkal House, Mannalamkunnu, Chevakaadu, Trissur, Kerala, India

*Corresponding Author: C Burnice Nalina Kumari, Senior Lecturer, Department of Periodontology, Faculty of Dentistry, Meenakshi Academy of Higher Education and Research, Chennai, India.

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Abstract
Following the extraction of maxillary posterior dentition, a combination of horizontal and vertical alveolar bone resorption with maxillary sinus expansion frequently results in lack of bone height for the replacement of missing teeth. This results in the widespread treatment need to restore masticatory function in the posterior maxilla. In situations where the inter-arch distance is normal or decreased, augmentation of maxillary sinus through a grafting procedure is probably the preferred approach for replacing the teeth with dental implants. Various sinus elevation techniques and graft materials are used to augment the maxillary sinus before the placement of implants. A-PRF (Advanced Platelet Rich Fibrin) is a third generation platelet concentrate, which offers an access to growth factors with a simple and available technology. It influences bone and soft tissue regeneration through the presence of monocytes/macrophages and their growth factors. This case report depicts sinus augmentation with A-PRF in combination with allograft to place the implant.

Keywords: A-PRF; Sinus Floor Augmentation; Allograft

Introduction
The utilization of dental implants in the rehabilitation of partially and completely edentulous patients is currently a widely accepted treatment modality [1]. The present challenge to the dentist both surgically and restoratively for replacement of missing tooth is the qualitative and quantitative limitation of the residual bone, often interrelated with the pneumatization of maxillary sinus [2]. Maxillary sinus is the pneumatic space that is lodged inside the body of the maxilla which communicates with the environment by way of the middle meatus and the nasal vestibule [6]. Since the introduction of sinus graft technique by Tantum in 1986 [3] and Boyne and James in 1980 [4], various types of graft materials and procedural modifications have been proposed to improve the efficacy of implant therapy. However, osseointegration of dental implants is highly predictable only when implants are completely embedded in the bone. Different surgical techniques proposed to address this clinical problem of bone loss in maxilla include-maxillary sinus floor augmentation [5], Le fort one osteotomy

with interpositional bone grafts, segmental bone onlays and subperiosteal implants. These procedures are meant to produce the formation of new bone in the lower portion of maxillary sinus thus increasing the height of crestal bone available for implant placement.

**Case Report**

A 26-year-old male patient reported to the department of Periodontology, Meenakshi Ammal Dental College and Hospital, Faculty of dentistry, Chennai, with the chief complaint of missing teeth in his upper left back teeth region for the past one year. On taking a detailed case history, patient revealed that the teeth were uneventfully extracted before one year due to decay. The clinical examination revealed missing 25 and 26 (Figure 1). The patient had no relevant extra-oral and intra-oral abnormalities. Blood investigations were done which revealed no systemic abnormalities. The patient was a non-smoker with no deleterious habits. The orthopantamograph (OPG) taken revealed that there was ideal bone height in region of 25 for the placement of implant, and reduced bone height in 26 region as the maxillary sinus remained close to 26 region interrupting the placement of implant (Figure 2). Since the defect falls under SA2 group of Misch classification, treatment was planned as initial sinus lift followed by placement of root form implant.

*Figure 1: Pre-operative view.*

*Figure 2: Pre-operative radiograph.*

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As the residual bone height in relation to 26 was only 4mm, a treatment plan of lateral wall approach sinus grafting and delayed implant placement was made. Two staged implant placement was planned in relation to 25 with the first stage to be done during the sinus lifting. All the procedures were fully explained to the patient and an informed consent was obtained.

**Preparatory phase**

Preparation of the patient included scaling and root planing of the entire dentition and oral hygiene instructions.

**Surgical procedure**

A single loading dose of antibiotic (amoxicillin 500 mg + clavulanate potassium 125 mg) was given 1 hour before surgery. The surgical procedures were performed under standard aseptic conditions. Local anaesthesia was achieved by posterior superior alveolar and greater palatine nerve block with 2% lignocaine and 1:80,000 adrenaline. Sinus lift was performed through lateral window approach technique.

Three incisions were given with a No.15 blade to elevate the mucoperiosteal flap in relation to 25, 26 region (Figure 3). Initial horizontal sub-crestal incision was placed palatally on the edentulous area extending as sulcular incision to adjacent tooth. Two vertical releasing incisions extending upto the mucogingival line were placed on the buccal side and a mucoperiosteal flap was raised with periosteal elevator to expose the anterolateral wall of the antrum. Under full exposure of the lateral maxillary wall, osteotomy was done to gain access to the sinus membrane (Figure 4). The dimensions of the osteotomy were determined based on the clinical and radiographic examination.
Lateral window was prepared in relation to 26 with rectangular shaped osteotomy preparation (Figure 5). Sharp edges were obtained using a round diamond and carbide bur at slow speed with copious saline irrigation. After completion of the osteotomy the bony wall was mobile and attached only to the underlying sinus membrane. The sinus membrane was gently reflected and elevated utilizing special curettes. Once properly detached and elevated, there was sufficient room for the placement of the graft. Biograft which is a biphasic synthetic bone graft of 60% synthetic hydroxyapatite and 40% beta tricalcium phosphate was used for grafting.

Advanced - Platelet Rich Fibrin (A-PRF) was prepared (Figure 6) according to Choukron’s protocol. 20 ml of intravenous blood was obtained from the patient by venipuncture of the ante-cubital vein. The blood was collected in sterile tube without anticoagulant and it was immediately centrifuged at 1500 rpm for 14 minutes for the preparation of A-PRF. After centrifugation, the structured fibrin clot was present in the middle of the tube leaving red corpuscles at the bottom and acellular plasma at the top. A-PRF was easily separated from the red corpuscle base using sterile tweezers and scissors. It was then transferred to the PRF box and compressed to obtain a PRF membrane. Then the prepared biograft and A-PRF were combined together and used to graft the medial part of the sinus followed by the distal part (Figure 7 and 8). Periocol collagen membrane barrier was used to cover the window of the lateral wall of the graft.
Osteotomy site was prepared according to the standard implant placement protocol in relation to 25. The osteotomy was initiated using a pilot drill of 2 mm followed by sequential drilling to prepare the site according to the selected implant size. Copious irrigation with saline was done during the surgical procedure. The implant was inserted with the help of insertion tool and a torque wrench. Minimum of 35-40 N cm of torque was achieved. The implant achieved excellent primary stability (Figure 9). After complete insertion of the implant into the bone, the primary cover screw was tightened to protect central screw hole. Then the flaps were sutured. Patient was recalled after 7 days for suture removal. Six months after the sinus lifting and graft placement, an IOPA was taken in the 26 region to assess the regeneration in that site. IOPA revealed a bone fill of 8mm which was ideal for the implant placement (Figure 10). Following this, first stage procedure was done in relation to 26 under standard implant placement protocol as mentioned earlier. At 9th month, abutment was placed in 25 and 26 (Figure 11). Provisional crowns were placed for both 25 and 26. At 12th month the provisional crowns were replaced by porcelain fused metal crown (Figure 12).

Figure 9: Implant placed in 25.

Figure 10: IOPA depicting implant in 26.

Figure 11: Abutments placed in 25, 26.

Post-op care and medication

The patient was prescribed antibiotics (amoxicillin 500 mg tid for 5 days) and analgesics (combination of ibuprofen 200 mg and paracetamol 500 mg twice daily for 3 days) and post-operative instructions were given. Chlorhexidine (0.2%) mouth rinse was prescribed for 4 weeks after surgery. Patient was advised the same prescription after each surgical procedure.

Discussion

Various conventional techniques of augmenting the sinus are the lateral window approach [8], osteotome approach [9], hydraulic sinus condensing [10] and antral balloon elevation [11]. Other specialized techniques like sinus elevation through a maxillary molar tooth extraction socket had also been tried [12].

Sinus grafting and implant placement procedures may be accomplished in one surgical phase, in which the implants and grafts are placed simultaneously or in 2 surgical phases in which the implant placement is delayed for several months to allow for graft maturation [13].

Various grafting materials like the autografts, allografts, alloplasts, xenografts, growth factors and tissue engineered bone can be used for sinus grafting. Membranes like titanium reinforced membranes, polytetrafluoroethylene membranes and porcine derived collagen barrier are used over the lateral window of the sinus along with the grafts in the augmentation of maxillary sinus.

The sinus augmentation procedure for posterior atrophic maxilla is becoming a well-established, predictable and accepted procedure. The ultimate goal of sinus augmentation technique is to increase the sinus height to that level necessary for dental implant placement. This lateral approach through trap-door window access is performed by the sequential procedures of flap entry, window access to the sinus cavity, elevation of the sinus (Schneiderian) membrane to create a space, surrounded by either periosteum or by bone tissue of the maxilla, for the resultant placement of graft material and flap closure.

While doing the sinus lift procedures, the practitioner inevitably encounters the internal structure of the maxillary sinus, which is the septum. Perforations of the Schneiderian membrane, which lines the sinus cavity, causes most intra-operative and post-operative complications and the presence of the septa leads to a higher incidence of perforations [14]. Antral septa are classified as primary or secondary. The primary bony projections of the maxillary floor divide the pyramid shaped sinus cavity into compartments. The secondary septa are shorter, protrusive bone spikes into the sinus, which occur following tooth extractions.
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The thickness of the Schneiderian membrane is highly variable; in health, it is generally less than 1 mm thick, but it can be more than 2 mm if inflamed. Any sinus pathology, which often manifests in the appearance of the membrane, must be resolved prior to surgical sinus interventions.

A variety of graft materials, ranging from autogenous (intraoral or extraoral) to various combinations of allografts, xenografts and alloplastic materials with predictable results have been reported [15]. Bone grafting of the maxillary sinus floor superiorly increases the bone height of the posterior maxilla and enables the placement of implants. Indications for sinus augmentation include loss of significant amount of bone in the posterior maxilla, pneumatized maxillary sinuses, poor bone density (D4 type - residual bone height is about 5 mm) and strong occlusal forces in the posterior maxilla.

Biograft is a synthetic biphasic calcium phosphate consisting of hydroxyapatite and beta-tricalcium phosphate in the weight % ratio of approximately 70:30 that is biocompatible, non-toxic, resorbable, non-inflammatory and bioactive. It causes no immunological, foreign-body or irritating response and has excellent osteoconductive ability [2,16].

A-PRF is a concentration of human autogenous platelets suspended in a small volume of plasma. It contains greater numbers of white blood cells and influences bone and soft tissue regeneration through the presence of monocytes/macrophages and their growth factors. Monocytes in A-PRF releases higher concentration of growth factors. The decreased centrifugation rpm and increased time gave enhanced neutrophil granulocytes in the distal part of the clot. Neutrophil granulocytes increases differentiation of monocytes and the PRF clots formed with A-PRF centrifugation protocol showed a loose structure with more interfibrous space, and more cells in distal part of fibrin clot. The distribution of cells is even in A-PRF clot [17]. Platelets initiate all bone and soft tissue healing via the expression of 7 growth factors- 3 isomers of platelet derived growth factor (PDGF-aa, PDGF-ab, PDGF-bb), 2 isomers of transforming growth factor beta (TGF-β1, TGF-β2), vascular endothelial growth factor (VEGF), epithelial growth factor and vitronectin [18]. When compared to other methods, in our case the incorporation of A-PRF accelerated the rate of bone formation and the amount of bone formed as it promoted the osteoprogenitor and vascular endothelial cells of the marrow cavity, the sinus membrane and the mucoperiosteal flap. Addition of collagen membrane together with Biograft and A-PRF in our case not only prevented the ingrowth of soft tissue, but also enhanced the protection of initial coagulum and its optimal degradation which led to the cascade of biological events resulting in regeneration. To the best of our knowledge this is the first case report where A-PRF was used in sinus lifting and implant placement.

Conclusion

Maxillary sinus grafting has become a routine treatment over the last ten years as it has allowed the placement of dental implants using simultaneous or staged procedures in sites in posterior maxilla that were previously considered unsuitable for implant placement because of insufficient bone volume. Over the past 15 years, various changes in surgical techniques have been applied to bone grafting of the floor of the maxillary sinus, mostly related to the use of different types of bone graft materials and different intra operative techniques. The use of A-PRF shows positive edge over conventional treatments in the process of regeneration as they release various growth factors. Even in our case having a unique combination of bone graft with A-PRF and collagen membrane instead of the commonly used barriers, proved to be a booster to both rate of bone formation and healing in the process of sinus augmentation.

Bibliography


