Case Report

APDDM mixed with i-PRF as a graft material for bone regeneration - A case report

ABSTRACT

Demineralized dentine matrix (DDM) has both osteoconductive and osteoinductive properties, and has porous structure which helps in cell and blood vessel penetration and the release of various growth factors from the dentinal tubules. The first human dentine autograft case was done in 2002 in Japan for maxillary sinus lifting. In this clinical report, we use a hand-operated order made stainless steel apparatus to crush the tooth and prepare the DDM chair side. Chemical treatment of DDM particulate was done for demineralization and sterilisation purpose, and used immediately as a graft material for socket preservation. Dentascan after 4 month showed remarkable bone at the site of grafting and implant was placed. The patient was restored successfully with their own DDM and implant-supported prosthesis.

Keywords: DDM, graft materials, implant, iPRF, regeneration, socket preservation

INTRODUCTION

Ridge resorption is a continuous and inevitable phenomenon. Various studies reported an approximately 50% of alveolar bone reduction over 12 months with more than two-thirds of the resorption in the first 3 months after extraction.[1-3] Rehabilitation with implant requires a sufficient amount of bone, if this minimal requirement is not met, an augmentation ridge procedure should be performed.[4]

The socket preservation with graft materials tends to reduce this bone resoption, most likely via the maintenance of physical stimulation of the surrounding bone.[4,5] Therefore, a bone graft is often necessary for bone augmentation.[6-8]

The demineralized dentine matrix (DDM) is now becoming a major attraction as a graft material for alveolar bone regeneration purpose as both alveolar bone and dentine are derived from neural crest cell.[9] The first clinical report on human bone autograft was done in 1820, first human dentine autograft was done in 2002 in Japan for maxillary sinus lifting case and was reported in 2003, 81st International association for dental research (Sweden).[10]

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Several studies have shown that both DDM and demineralized bone matrix (DBM) have similar chemical composition[11-13] Both DDM and DBM are composed of predominantly type 1 collagen (95%) and the remaining part is non-collagenous protein and trace amounts of various growth factors.[14,15]

Due to chemotactic properties for osteoblasts and osteoprogenitor cells, autogenous partially demineralized dentine can promote bone regeneration in reconstructive implant dentistry including socket preservation, alveolar bone augmentation, guided bone regeneration and maxillary sinus bone augmentation.[16]

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The goal of this case report was to evaluate the regenerative potential of DDM with i-PRF graft in socket preservation.

CASE REPORT

A 35-year-old female patient was reported to the Unit of Prosthodontics, Faculty of Dental Sciences, Institute of Medical Science, Banaras Hindu University with chief complaint of dislodged prosthesis of the upper front region. Her past dental history revealed the RCT of the same tooth. The pre-operative intra-oral view is shown in Figure 1.

On clinical examination, tooth #21 and #22 was prepared for crown in a private dental clinic. Radiographic examination (IOPA) [Figure 2] confirms the RCT of #21, and overcutting and perforation was present with respect to #22. Consultation with an endodontist was done for #22 and was advised for extraction of #22 as endodontic treatment had poor prognosis. Crown fabrication for #21 and extraction followed by socket preservation and implant-supported prosthesis for #22 was planned. The treatment plan was discussed with the patient and informed consent was obtained. All the necessary investigations were done.

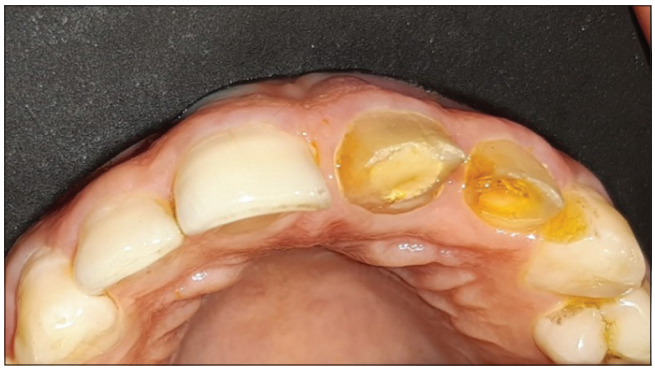

Figure 1: Pre-operative intaoral view

Figure 3: Extracted teeth

Surgery 1

The bone mapping was done in the region of #22, 3 mm below the marginal gingiva, the faciopalatal width measured was 5.8 mm. The tooth #22 in need of extraction was cleanly extracted under local anesthesia [2% lignocaine HCL with epinephrine (1:100,000)] [Figure 3]. The extraction socket was prepared and debrided with surgical curette and rinsed with metronidazole injection and was packed with gauge [Figure 4].

DDM preparation was done with the following protocol

Following clean extraction, the teeth was held with tissue forcep, the soft tissue, the debris attached, was removed using surgical bald parker blade no #15 and enamel was removed using dental bur, and the teeth was washed twice in normal saline [Figure 5]. The tooth was crushed with hand-operated order made stainless steel apparatus [Figure 6] and the particulate was sieved through 1200 nm and 500 nm sieve [Figure 7]. The collected particulate graft material was then placed in the beaker along with 2% HNO_3 for 30 minutes for the demineralization of particulate graft. Afterwards, particulate graft material was collected and washed with normal saline twice. Further, the demineralised graft particulate was placed in another beaker along with 0.5M

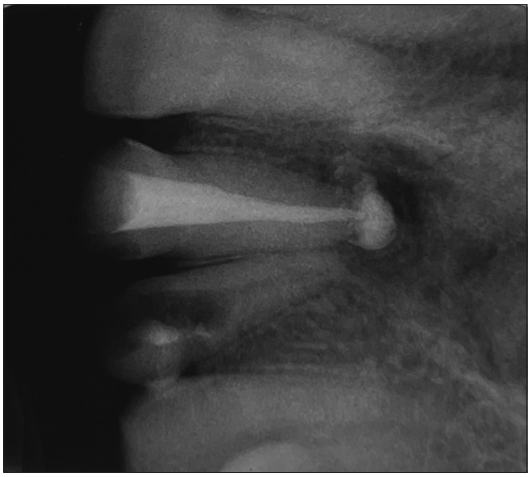

Figure 2: Pre-operative IOPA radiograph

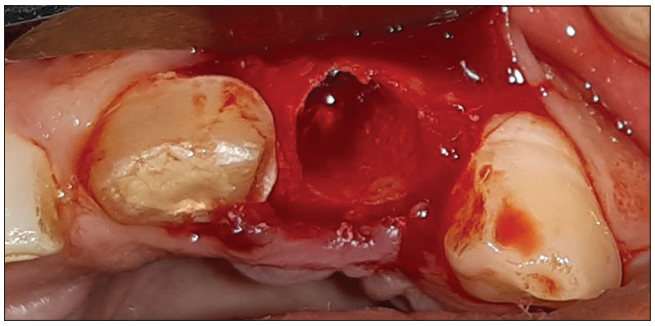

Figure 4: Extraction socket prepared

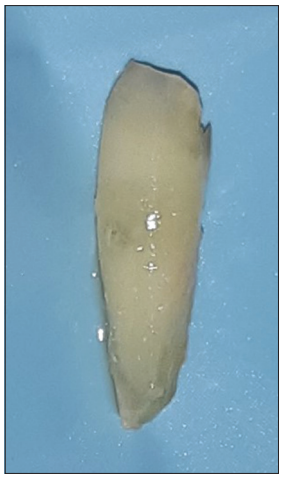

Figure 5: Cleaned extracted teeth

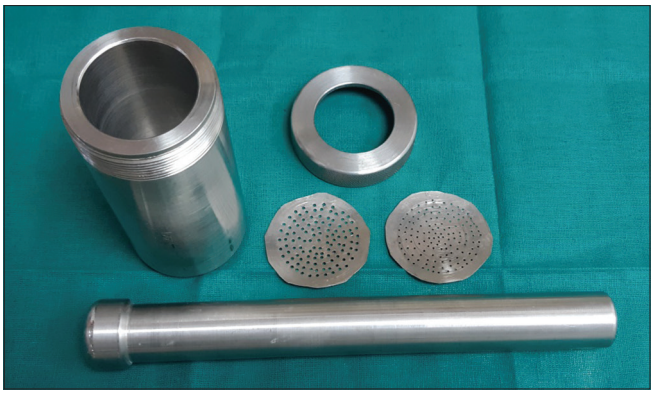

Figure 6: Hand operated order made stainless steel apparatus and sieves of size: 500, and 1200 nm

Figure 7: Crushed tooth particulate of particle size ranges from 500 nm to 1200 nm

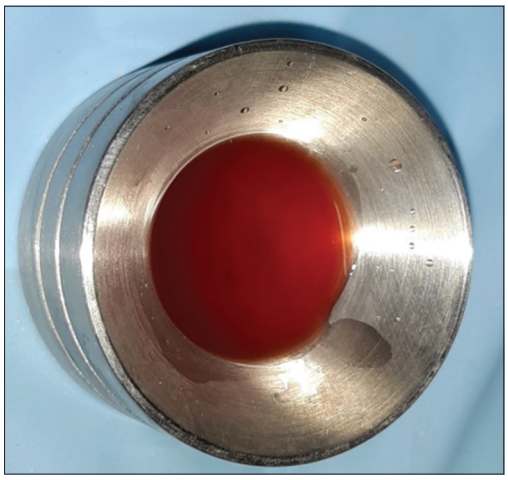

Figure 8: i-PRF

sodium hydroxide for 10 minutes and again rinsed with normal saline. Demineralized graft particulate was placed in 30% ethyl alcohol for 5 minutes and then rinsed thoroughly with normal saline.

In parallel, 10 ml of venous blood was drawn from the patient and collected in vial without anticoagulant and immediately centrifuged at 700 rpm for 3 minutes to prepare injectable plasma-rich fibrin (i-PRF). The upper liquid layer was collected as i-PRF [Figure 8]. Particulate graft material was mixed with i-PRF and left for 15 minutes to form the sticky graft material [Figure 9] (composite graft material). Composite graft material was placed firmly (not with due pressure) in the extraction socket and covered by periocol membrane to prevent the invagination of epithelium [Figure 10]. Intermittent sutures were given with 3-0 non-resorbable black silk suture. Post-operative instructions were given to the patient and prescription of antibiotics, analgesics, anti-inflammatory and chlorhexidine mouth rinse for 7 days was advised. Patient was recalled for suture removal after 7 days. Cantilever provisional prosthesis was given to the patient where #21 acts as abutment [Figure 11]. Patient was recalled after 4 months for implant placement.

Surgery 2

After 4 months of healing period, radiographic examination (denta scan) was done, bone width measured in the buccopalatal direction #22 region was 4.6 mm [Figure 12]. 3.0 × 11.5 (Adin NP) implant was decided for placement. The cantilevered part of provisional prosthesis was removed using dental bur and surgical intervention for the implant placement was done. On the day of surgery antibiotic prophylaxis with amoxicillin and clavulanate was prescribed 1 hour before surgery. Local anaesthesia [2% lignocaine HCL with epinephrine (1:100,000)] and crestal incision were given over the healed edentulous site. Full-thickness mucoperiosteal flap was reflected and the alveolar ridge was exposed followed by osteotomy. Implant of size 3.0 × 11.5 was placed [Figure 13]. The flap was approximated and sutured with 3-0 non-resorbable black silk suture. Post-operative instructions were given to the patient and

Figure 9: Sticky composite graft

Figure 11: Provisional cantilevered prosthesis with #21 as an abutment

prescription of antibiotics, analgesics, anti-inflammatory and chlorhexidine mouth rinse for 7 days was advised. Patient was recalled for suture removal after 7 days. Patient was recalled after 3 months for prosthetic rehabilitation purpose.

Prosthetic phase

After 3 months of implant placement patient was recalled for the second stage surgery and healing abutment was placed [Figure 14]. Patient was recalled after 10 days of second stage, provisional prosthesis of #21 was removed and finishing of the tooth was done for prosthesis fabrication. Implant level impression of #22 was made using additional silicone impression material with open tray impression coping. Prosthetic rehabilitation of #21 with all ceramic crown and #22 with cement retained all ceramic crown was done [Figure 15].

DISCUSSION

Urist *et al*., first discovered the bone-inducing property of rabbit dentine in the intramuscular pockets of rabbit in the year 1967 and also stated non-DDM induced bone formation in 8-12 weeks after implantation while DDM induced bone formation in 4 weeks in rabbit and rat.[17,18] Some literature[19] suggests that this may be

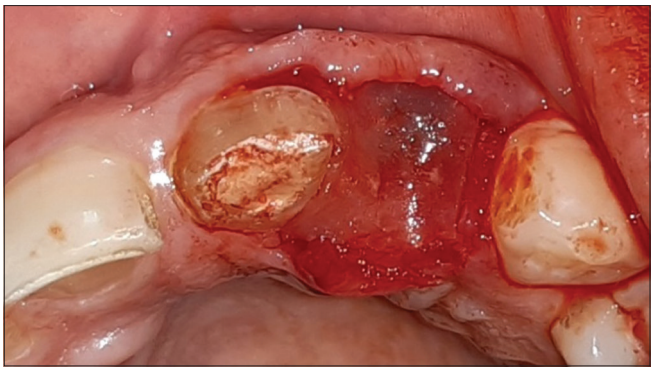

Figure 10: Sticky composite graft filled in the socket and secured with periocol membrane

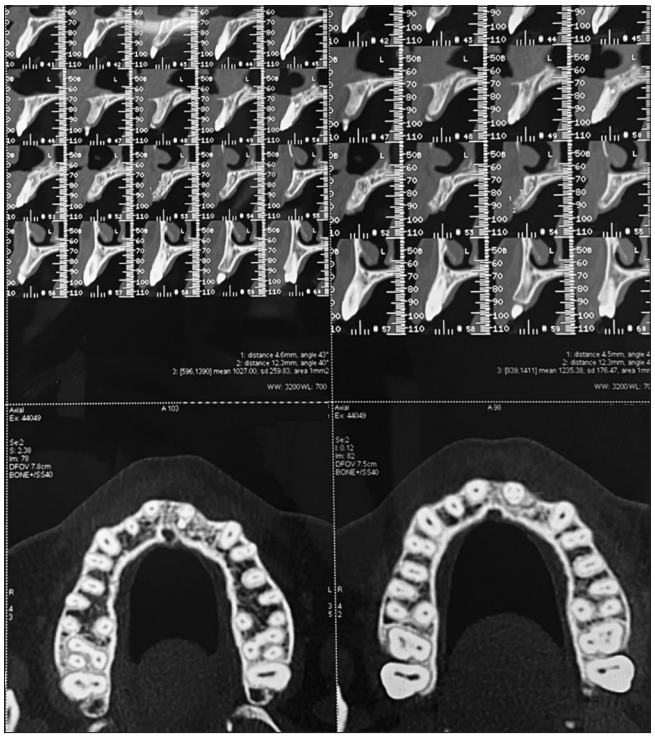

Figure 12: Dentascan was done faciopalatal width measured was 4.6 mm

due to that DDM has wide dentinal tubules compared to NDDM, leading more release of growth factors from DDM and also DDM has lesser inorganic content, induces bone formation faster compared to NDDM. This case report also confirms the wider diameter of dentinal tubules of deminralised dentine matrix in scanning electron microscope (SEM) images [Figures 16 and 17].

Demineralisation of the dentine matrix depends on the size of the particulate graft particulate. Koga *et al*.,[20] in their study describes the time required for 70% demineralisation (partial demineralised dentine matrix) and complete demineralisation of dentine matrix in 2% HNO_3. They concluded that partial demineralisation of dentine requires 5, 10 and 20 minutes and for complete demineralisation of dentine took 60, 120 and 180 minutes for the particles of sizes; 200, 500 and 1000 µm,

Figure 13: 3.0 × 11.5 NP implant placed

Figure 14: Healing cap placed after second stage surgery

Figure 15: Final all ceramic prosthesis given

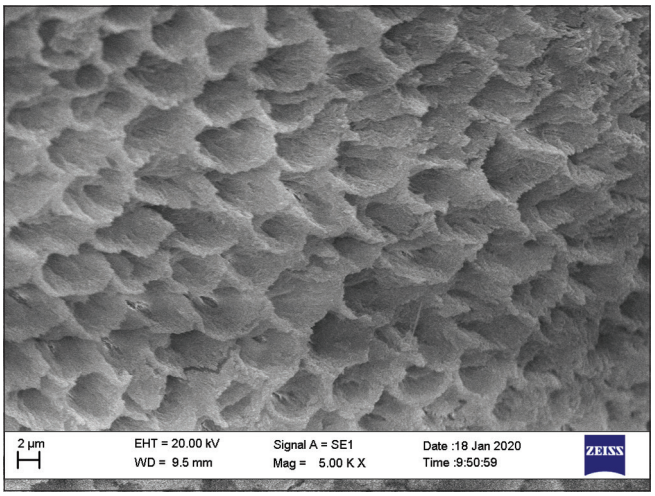

Figure 16: SEM images of DDM demineralized with 2% HNO_3 at 5K magnification

respectively. In our case report, we used the 2% HNO_3 for 30 minutes for the partial demineralisation of the dentine matrix of particles sizes ranges from 500 nm to 1200 nm.

DDM possess osteoconductive and osteoinductive properties, and has porous structure which helps in cell and blood vessel penetration and in the release of BMPs along with other growth factors from the dentinal tubules. DDM also has adequate mechanical stability to withstand compression and tension, biodegradability, adhesiveness to adjacent bone and most importantly to retain the protein for a sufficient time. Thus, acts as a very good graft material.[21-23]

The first tooth bank (Korean tooth bank R and D centre) was established in 2009 in Seoul, Korea with the unique service dedicated for the tooth-derived graft materials.[19] Demineralized dentin and freeze dried dentin have been more extensively researched and secured a place as graft materials.[24,25] The processing of these materials takes place in a laboratory and the extracted tooth cannot be used immediately. Some clinical studies,[26] supports the use of crushed teeth through disposable grinding chamber of smart dentin grinder as an alternative to another graft substitute. Special dentine grinder follows a simple protocol, but the cost is not once a time for smart dentine grinder but has to use new disposable grinding chamber each time to use the teeth as a graft material.

In this case report, we use order made stainless steel apparatus to crush the teeth and follows a simple chemical treatment to demineralise and disinfect the graft material. The advantages of using this technique are: graft cost was minimal, chair side procedure to prepare the graft and use immediately, less time consuming.

CONCLUSION

This case study describes the chair side preparation of autologous tooth bone graft (DDM) mixed with i-PRF used

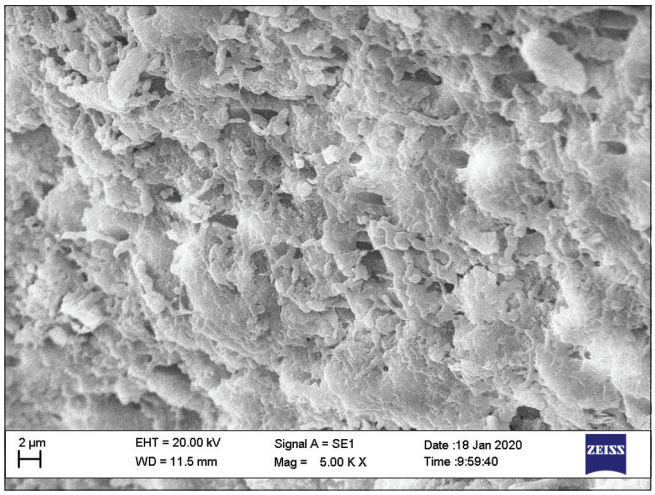

Figure 17: SEM images of undemineralized dentine matrix at 5K magnification

immediately for the socket preservation and showed the promising results in terms of quality and quantity of bone formed and further implant placement. It is a simple, cost effective, procedure to form autogenous demineralised dentine matrix graft material which can be used easily in future.

Authors contribution

PG did the initial screening of the patient. PG and AS contributed in treatment planning and execution of the treatment. PG drafted the initial manuscript. AS did the final editing of the manuscript. Final manuscript was approved by both the authors.

Ethical considerations

The Authors confirms that this study has been prepared in accordance with COPE rules and regulations. Given the nature of the study, the IRB review was not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent form. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patients understand that her name 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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