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Management of post-extractional alveolar socket with mineralized plasmatic matrix before implant placement: a case report

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ABSTRACT

When activated the platelets release growth factors that play an essential role in bone healing such as Platelet-derived Growth Factor, Transforming Growth Factor-β, Vascular Endothelial Growth Factor and others. Several techniques for platelet concentrates such Platelet Rich Plasma (PRP) and Platelet Rich Fibrin (PRF) have been introduced in surgical field for the prevention of hemorrhage and acceleration of tissue regeneration. Recently, a novel technique of fabricating growth factors-enriched bone graft matrix have been proposed termed as "sticky bone" or "mineralized plasmatic matrix", which contains platelets and fibrin concentrate in a liquid state; these materials can become bound to bone particles. The filling material is easy to shape and a PRF-type membrane is also generated. In our case report, mineralized platelet matrix have been used after the extraction of a fractured single rooted tooth in order to preserve the dimensions of the post-extractive socket, facilitate new bone formation and to reduce healing time.

Keywords: Platelet concentrate, growth factors, bone regeneration.

Introduction

In order for a dental implant to be restored optimally, it must be placed in an ideal anatomic position. However, this is not always possible since physiological wound healing following tooth extraction, trauma, or pathology, often results in a deficiency of both hard and soft tissue. Numerous augmentation techniques are currently in use to create sufficient bone volume for reliable placement of endosseous implants in severely resorbed edentulous alveolar ridges [1].

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Recently, the use of platelet concentrate in combination with graft materials is increasingly recommended. Platelet is known to contain high quantities of growth factors, such as transforming growth factors ß-1 (TGFß-1), platelet-derived growth factor (PDGF), epithelial growth factor (EGF), insulin growth factor-I (IFG-I) and vascular endothelial growth factors (VEGF), which stimulates cell proliferation and up regulates angiogenesis[2].A concept of fabricating growth factors-enriched bone graft matrix, also known as "sticky bone" or mineralized plasmatic matrix (MPM), using autologous fibrin glue has been demonstrated. Sticky bone provides stabilization of bone graft in the defect, entraps platelets and leukocytes in its fibrin network, and therefore, accelerates tissue healing and minimizes bone loss

during healing period and prevents in growth of soft tissues in graft [3].

Case report

A 50-year-old male patient, nonsmoking, without any history of systemic disease was referred to our periodontal department, after several episodes of abscesses related to the 45. The clinical examination was shown the presence of fistula in buccal region and the presence of large and deep periodontal pocket in the vestibular site. Vitality tests on tooth were negative and vertical percussion pain was present. Retroalveolar radiographic examination showed a diffuse, radiolucent periapical image in endodontically treated tooth (Fig.1) and cone beam computed tomography (CBCT) examination showed a wide vestibular bone defect (Fig. 2).A full-thickness gingival flap was performed and after initial curettage of granulation tissue it was possible to visualize significant labial bones lose "fenestrated labial bone" and a vertical root fracture in buccal-lingual direction indicating the tooth for extraction (Fig 3). Immediate implant placement was not possible, so extraction and socket preservation using sticky bone was planned.

Protocol for the preparation of MPM using ATOLL MPM KITs

Blood samples were placed in 10 mL glass-uncoated plastic test tubes (We needed 4 tubes) without anticoagulant and immediately centrifuged at 2700 rpm for 15 minutes. Out of the two layers obtained, the deeper layer is red blood cells (RBC's) and the superficial layer is autologous fibrin glue (AFG). This AFG is then extracted from 2 tubes using a syringe (Fig.4) and mixed with particulate bone powder (GeistlichBio-Oss®) and 2.5 ml of physiologic saline (0.9% NaCl) and allowed to rest for 5-10 min for polymerization, which results in a red colored mass called "sticky bone" (Fig.5). The AFG extracted from the other tubes was reserved to create a PRF membrane obtained after compression. Atraumatic extraction was carried out without damaging the surrounding remaining bone, and the site was thoroughly debrided by mechanical means "curettage & irrigation" to remove granulated tissue (Fig.6). The MPM, which has been obtained, was placed in the extraction socket; the edges of the mucosal flaps were approximated to each other and sutured using 5-0 resorbable filament sutures (vicryl^{R}) (Fig.7a, 7b). The extracted tooth was sectioned and used as provisional restoration by bonding the crown to the adjacent teeth. After the surgical procedure, antibiotic therapy (amoxicillin 500 mg, 3 times/day) was started and maintained for 7 days. Anti-inflammatory and analgesic were prescribed for 3 days. The use of 0.12 percent chlorhexidine oral rinses twice a day was indicated during 7 days. Four month later, clinical and radiographic evaluation was carried out, which revealed excellent soft and hard tissue healing (Fig.8a, 8b). After preparation of the site, an implant of 4.3 mm in diameter by 10 mm long was installed (Neodent, Titamax CM/EX). On the day of surgery, the patient received 2 g of amoxicillin 1 hour before surgery. After a healing period of about 4 months, a screw-type implant-supported provisional restoration was placed, and the implant started occlusal loading. Following 1month definitive prosthetic rehabilitation was carried out using ceramic-metal crowns (Fig.9). At the 2-year follow-up examination, the implants were fully osseointegrated, presenting satisfactory functional and esthetic conditions without clinical or radiographic signs of alterations or pathologies (Fig.10).

Discussion

Vertical root fracture (VRF) is an untoward complication to root canal therapy that often calls for tooth extraction. It may be initiated during the filling procedure or subsequently because of stress factors maintained by forces of mastication [4].The typical pattern of bone resorption facing these teeth was described by Lustig et al.[5] as 'dehiscence' and was found in the buccal plate in 90% of the cases examined. Initially, when a thin buccal plate is resorbed, a narrow bone cleft develops and resorbs in an apico-coronal direction; it propagates with the fracture to form an oval or oblong type of bone resorption. At a later stage, the bone defect becomes wider as it extends laterally to the interproximal areas. This is a rather typical feature seen after flap reflection and removal of the granulation tissue. Also, Post-extraction alveolar bone changes have been estimated to cause 50% reduction in the bucco-lingual width of alveolar bone [6].A systematic review evaluated the dimensional changes of the alveolar ridge following tooth extraction and showed a mean reduction of 3.8 mm in width and 1.24 mm in height in the first six months [7].The predictable order of bone resorption is known, with the buccal aspect resorbing first [8]. Greater resorption in width than height [9],and with the mandibular bone resorbing faster than the maxillary bone [10].Insufficient bone may compromise dental implant treatment with a risk of injuring the anatomical structures. Therefore, adequate alveolar ridge preservation is essential for an esthetical outcome and correct implant placement[11].Alveolar socket Preservation techniques include the use of grafting materials of human, animal

or synthetic origin, with or without the use of barrier membranes [1],

Guided bone regeneration (GBR) is a well-known and accepted procedure for effective treatment of oral bony defects [1]. However, it has certain disadvantages such as:

1- Particulate bone graft is easily migrated when grafted on the large horizontal/vertical bone defect
2- Procedures are surgically time consuming and technique sensitive.
3- The early exposure of membrane can cause bone infection which may lead to total failure of the regeneration process.
4- Nonresorbable membranes require a second surgical intervention in order to be removed.
5- Additional membrane price.

Recently, to improve the biologic characteristics of the implanted material and the graft success rate, autologous blood products rich in platelets and growth factors are increasingly used. A synergy could be established between the stimulating action of growth factors and the target cells attracted into the environment favorable to bone regeneration which is created by osteoconductive scaffolds. Several In vitro studies, animal experiments and clinical trials suggested that platelet concentrates may effectively trigger stimulation of osseous and soft tissue regeneration, and reduce inflammation, pain and unwanted side effects [12-14].The platelet concentrates contain a high concentration of growth factors such as platelet-derived growth factor (PDGF), trans- forming growth factor-b1 (TGF-b1) and b2 (TGF-b2), fibroblast growth factor (FGF), vascular endothelial growth factor (VEGF), and insulin-like growth factor (IGF)[15], which enhance the healing process. This may lead to better bone repair and regeneration [16].Platelets also play a role in host defence mechanisms at the wound site, by delivering signalling peptides which attract macrophage cells 45. Platelet concentrates may contain small amounts of leukocytes that synthesize interleukins involved in the non-specific immune reaction 16, 74. Antimicrobial activity of platelet concentrates against several bacterial species involved in oral infections has also been reported [18].

Several techniques to collect platelet aggregate have been utilized Choukron's PRF and Sacco's CGF are recently developed platelet aggregation. These two methods collect leukocyte and platelet rich fibrin gel using a natural coagulation process. Compared to PRP and PRGF, PRF and CGF have many advantages over PRP. First, PRF can be squeezed to form a membrane and can be used as fibrin bandage serving as a matrix to accelerate the healing of wound edges [19]. Second, PRF does not use bovine thrombin or other exogenous activators in the preparation process [20]. Its natural fibrin architecture seems responsible for a slow release of growth factors and matrix glycoproteins during 7 days [21].Third, the chairside preparation of PRF is quite easy and fast and simplifies processing without any artificial biochemical modification; fourth, this produces an inexpensive autologous fibrin membrane in few minutes and eliminates the cost of membrane. The prospective cohort study conducted by Barone and al. in treating full or partial buccal bone defects of fresh extraction sockets in the esthetic zone showed that xenograft and PRF can be considered effective in repairing bone defects before implant placement. Moreover, they observed that the secondary soft tissue healing over the grafted sockets did not compromise bone formation [22].According to a study by Cagasan and al. It was observed that the concentrated growth factor had positive effects on implant stabilization. The ISQ measurements at week 1 and week 4 were notably higher in the study group. Application of CGF seems to accelerate osseointegration[23].In a histologic study realized by Geurs and al. evaluating the effect of PRP and rhPDGF-BB on early remodeling. They conclude that the Inclusion of PRP and rhPDGF-BB produced less residual bone graft material, indicating more rapid turnover of bone graft [24].Mineralized Plasmatic Matrix is a homogeneous product of mixing of two phases: the plasma phase and the mineral phase of bone graft that can be autogenic, allogeneic bone, or a bone substitute like xenogeneic bone synthetic. Scanning electron microscopy (SEM) reveals that MPM creates a dense fibrin network woven around the mineral particules [25]. They present several advantages: it is moldable, contains the mineral phase which is the scaffold for bone cells necessary for bone formation. prevent micro and macro movement of grafted bone. Fibrin network entraps platelets and leukocytes to release growth factors and no biochemical additives are needed.

Conclusion

The extraction socket preservation technique conserves the alveolar architecture and prevents hard and soft tissue collapse that minimizes the necessity for further augmentation procedures in implant placement. MPM can be an effective procedure for socket preservation due to his numerous advantages. It may serve as a third-generation platelet concentrate with potential applications in various fields. Therefore, clinical and comparative studies are needed, to confirm biologic

qualities of MPM and to define its place in alveolar preservation techniques.

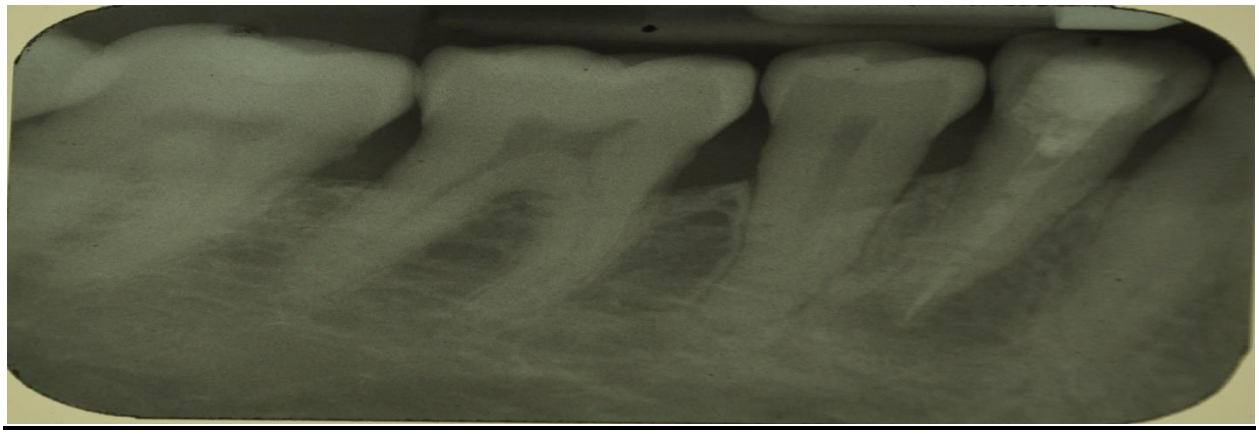

Fig 1:Retroalveolar radiographic showed a root canal treated mandibular first premolar with latero-apical radiolucency

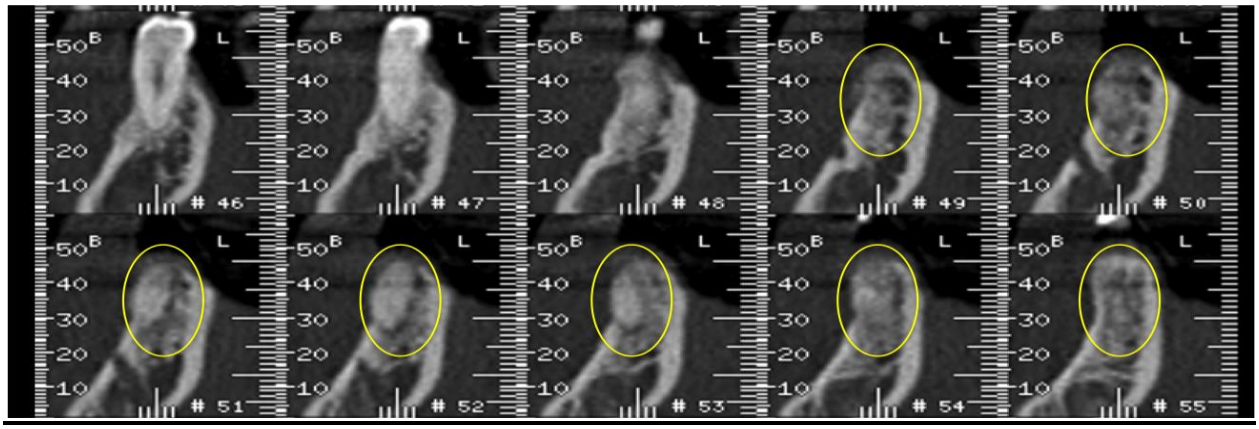

Fig 2:Cone beam computed tomography showed awide vestibular bone defect on first mandibular premolar

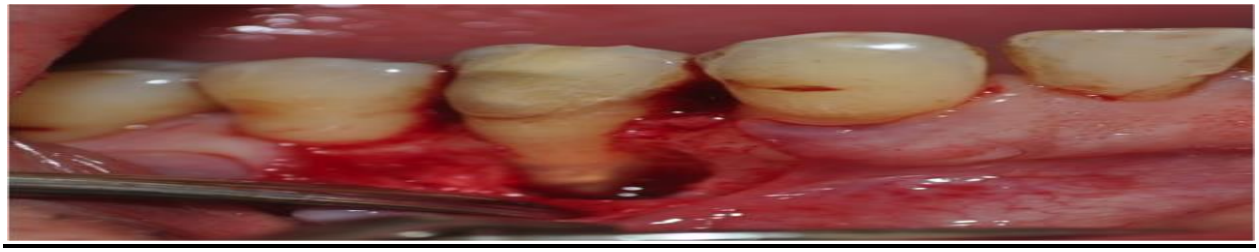

Fig 3: Clinical aspect of the root after full flap elevation showing the vertical root fracture and bone fenestration

Fig 4: Autologous fibrin glue extracted from tube using a syringe

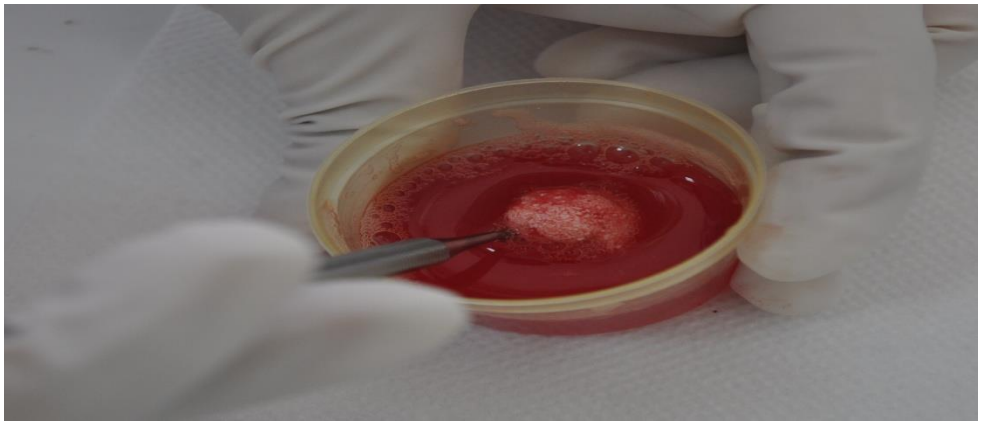

Fig 5: Red colored sticky bone after polymerization

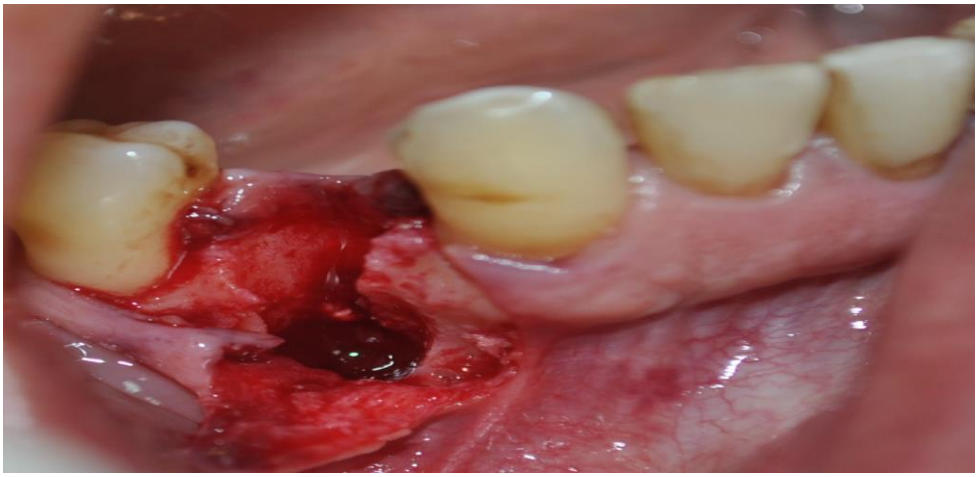

Fig 6:Alveolar bone defect after extraction and curettage of granulated tissue

Fig 7a: Grafting of the Mineralized Plasmatic Matrix

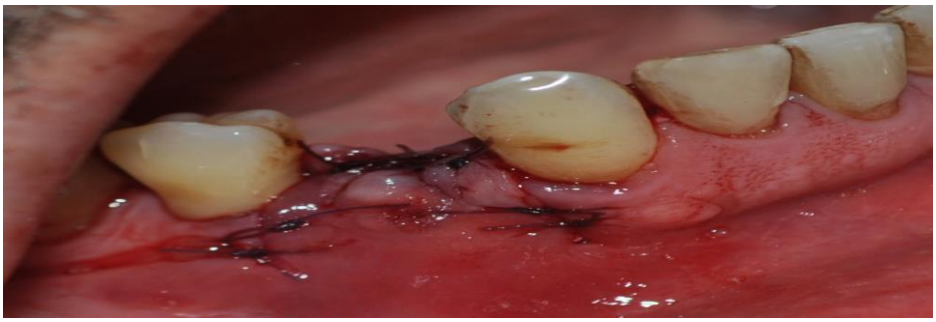

Fig 7b: Suture of the coronally advanced flap

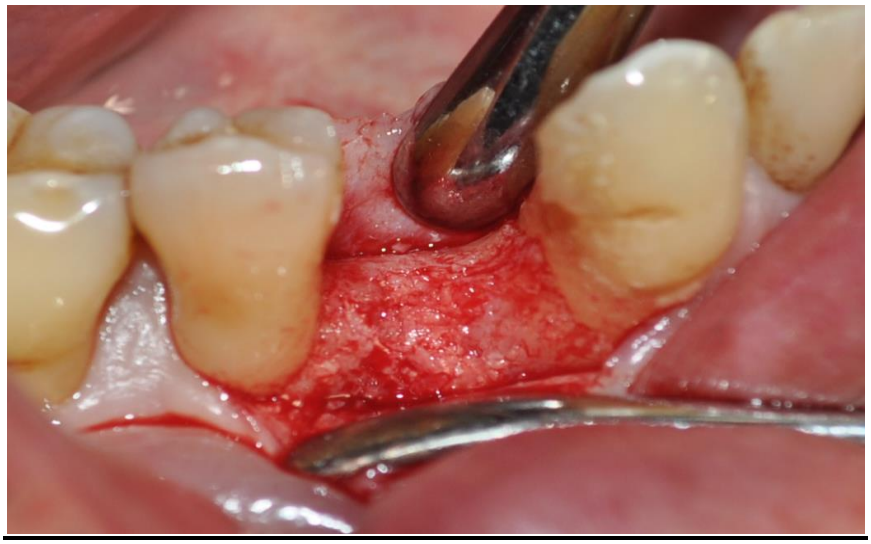

Fig 8a: Clinical aspect after 4 month of healing

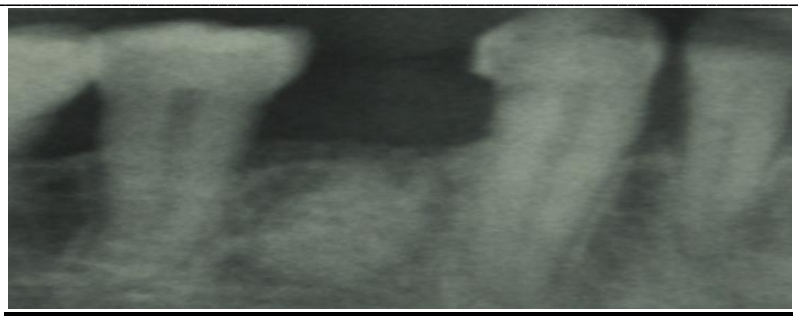

Fig 8b: Radiographic aspect after 4 month of healing

Fig 9:Definitive restoration with ceramic-metal crown

Fig 10: 2 years follow up

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