A STRATEGY TO MITIGATE CRESTAL BONE LOSS AROUND DENTAL IMPLANTS - PRF AND BONE GRAFT APPLICATION - A CASE REPORT

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ABSTRACT:

Crestal bone loss around implants can ultimately lead to implant failure if not treated in the initial stages. This can not only compromise on the prosthetic outcome but can also tire the patient financially. Bone grafts and platelet rich fibrin have often been used while placement of implants especially if the bone quality or thickness seems compromised. It acts as a scaffold that is Osseo conductive for bone generation. **Objective:** In this case report the predictability of bone regeneration using PRF along with bone graft was tested. **Results:** showed a successful bone regeneration and thus can be employed as a method for treating peri-implant bone loss.

INTRODUCTION:

Tooth replacement with dental implants has led to an important revolution in modern clinical dentistry. Brane mark first introduced Osseo integrated dental implants to allow firm anchorage of titanium implant screws into living bone, a process referred to as Osseo integration.[1]

Implant-based treatment is a growing part in the modern dentistry. Loss of alveolar bone around dental implants is revealed in 5-10% of patients. A dental implant is considered to be a failure if it is lost, mobile, or shows peri-implant bone loss of greater than 1.0 mm in the first year and greater than 0.2 mm a year after. Peri-implantitis can result in bone loss around the implant and eventual loss of the implant. Peri-implantitis is a site-specific infectious disease that causes an inflammatory process in soft tissues and bone loss around an Osseo integrated implant in function.[2] The long-term clinical success of dental implants depends mainly on the preservation of the bony support around the implant, which is usually evaluated with radiographic images.[3]

In the peri-implantitis treatment together with operative and conservative treatment, bone substitutes are often used to replace the bone defect. One of the materials is

bone graft containing hydroxyapaptite crystals that may be an allograft, xenograft or alloplast. They are used since they do not evoke adverse cellular reactions, and in time, the material is either replaced by bone or integrated into the body, depending on the degradation properties.[4,5]

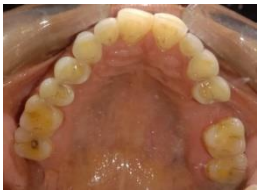
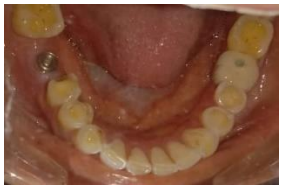
Platelet concentrates (platelet-rich-fibrin) are obtained by centrifugation of blood, following a method first described by Choukroun and colleagues. These materials contain high concentrations of growth factors (PDGF, TGF-β, IGF and VEGF), and inflammatory molecules (IL-1β, IL-4, IL-6 and TNF-α), and they could enhance the healing process, possibly leading to better bone repair and regeneration.[6]

The aim of this report is to describe a successful method of bone regeneration followed by prosthetic rehabilitation around an implant with crestal bone loss of 2mm using a platelet rich fibrin and bone graft of hydroxyapatite crystals.

CASE REPORT:

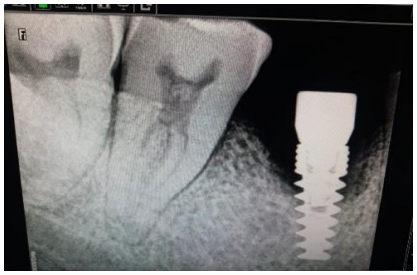
A 48-year-old male patient reported to the Department of Prosthodontics and Crown & Bridge, Kamineni Institute of Dental Sciences, Narketpally, Nalgonda with a chief complaint of difficulty in chewing food since 5 months and wants prosthesis in the implant site in the relation to lower right back tooth region. Medical history revealed that patient was diabetic since 6 years and is on medication. Dental history revealed that Implants placement was done in relation to 36 and 46 teeth region 5 months back.

Extra oral examination showed no gross abnormality detected. Intra oral examination revealed no abnormality detected in the soft tissue region whereas, hard tissue revealed teeth missing included 25. Generalized attrition present and implant supported crown in relation to 36 and implant in relation to 46 **(**Fig:1).

Pre-operative Occlusal view of Maxillary and Mandibular arches (Fig:1)

Pre-operative RVG showed crestal bone loss observed mesially and distally around implant i.e, of 2mm in relation to 46 **(**Fig:2).



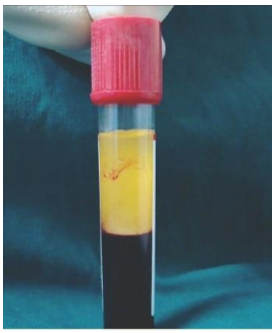
Pre-operative RVG (Fig:2)

PROCEDURE:

Crestal incision was made with 11 number blade under local anesthesia (Inferior alveolar nerve block, lingual nerve and buccal nerve block) at 46 region. Flap reflection done. Granulation tissue was removed from the site, implant threads were cleaned with titanium brush and treated surface with tetracycline powder slush.

Preparation of platelet-rich fibrin: -
6 ml of venous blood collected from the patient in the sterile vacutainer tube of 10 ml capacity. The vacutainer tube is then placed in a centrifugal machine at 3000 revolutions per minute for 10 minutes, after

it settles into the layers. A fibrin clot is then obtained in the middle of the tube, just between the red corpuscles at the bottom and acellular plasma at top **(**Fig:3).

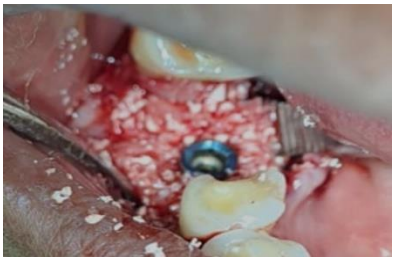


After centrifugation (Fig:3)

Isolated PRF (Fig:4)

The PRF clots were recovered and used in two ways as follows:

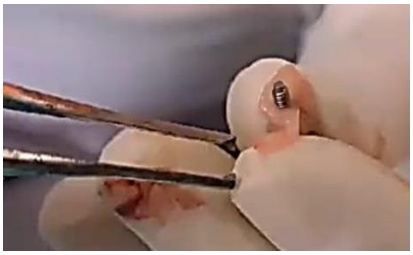
1. A few were placed in sterile cups and cut to smaller fragments. Then, they were mixed with demineralized bone matrix (DMBM), which is an allograft material. The mixture obtained constituted an easy- to-use homogenous graft material which was placed in the gap between the implant surface and the bone socket **(**Fig:5).



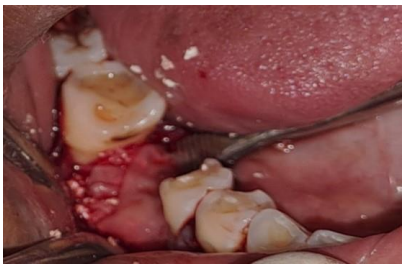
PRF clots mixed with sticky bone graft placed irt 46 (Fig:5)

2. The other PRF clot was packed tightly in two sterile compresses to obtain resistant fibrin membranes, which was placed over the implant surface with cover screw before wound closure (Pouch technique) **(**Fig:6).

PRF membrane (Fig:6)



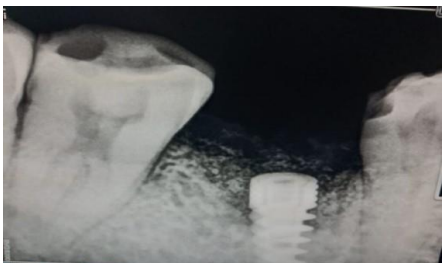
PRF membrane inserted around the cover screw irt 46 (Fig:7)



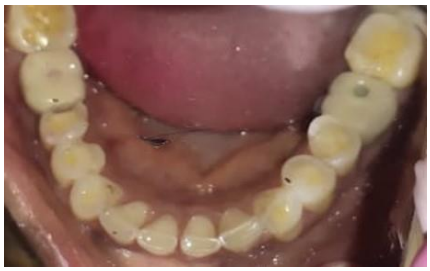
PRF membrane placed over the graft and implant irt 46 (Fig:8)

Simple interrupted sutures given with 3-0 braided sutures and COE-PAK was placed in the region of 46. After 3 months, patient was recalled for second stage, revealed clinically healthy peri-implant soft tissues, no signs of complications of bone loss but bone formation was observed around implant in relation to 46 i.e., of 2mm, followed by jig trial; abutment selection done and finally restored with cement

retained implant prosthesis in relation to 46 **(**Fig:10).



IOPA represents 3 months after graft placement irt 46 (Fig:9)



Cement retained prosthesis irt 46 (Fig:10)

DISCUSSION:

Bone loss around dental implants is generally measured by monitoring changes in marginal bone level using radiographs. After the first year of implantation, an implant should have <0.2 mm annual loss of marginal bone level to satisfy the criteria of success. However, the success rate of dental implants depends on the amount of the crestal bone around the implants.[6]

Prosthesis characteristics (retention method, number of elements), and dental implant characteristics (diameter, surface treatment, connection type and overloading) influences marginal bone loss.[7]

In the present case report bone loss around the implant was seen after 5 months of implant placement, probable factors for bone loss:

1. Patient being a diabetic since 6 years the blood supply can be compromised to the bone.
2. Patient being a female with post-menopausal age (age - 48yrs) there are more chances of osteoporosis and associated bone loss with it.

Glycemic control is a primary consideration for patients with diabetes, and there is a clear correlation between glycemic control and the development of microvascular and macro vascular complications (Cohen and Horton, 2007). Tissue hyperglycemia affects every aspect of wound healing by adversely affecting the immune system, including neutrophil and lymphocyte function, chemotaxis, and phagocytosis (Goodson and Hunt, 1984). These effects are suggested to affect the osseointegration.[8]

Osteoporosis is defined as a generalized skeletal disease noted by decreased bone mass and degradation of the microarchitecture of the bone tissue caused by increase of the marrow spaces, resulting in fragility of the bone tissue with subsequent greater risk of fractures. Bone density starts to decrease with lowered levels of oestrogen around the time of menopause. And it continues to decrease after menopause. Having lower levels of oestrogen increases the risk of developing osteoporosis. On average, women lose up to 10% of their bone mass in the first five years after menopause. Osteoporosis is a condition where your bones weaken (are less dense), causing them to break or fracture more easily.[9]

As these both conditions can be attributed to the bone loss in the present scenario, a technique that would fasten the process of osteogenesis by innately possessing Osseo conductive and Osseo inductive properties is anticipated to produce better results and thus platelet rich fibrin was used along with a bone graft that acts like a scaffold for the regeneration.

Platelets' regenerative potential was reported in the 70's, when it was observed that they contain growth factors that are responsible for increase collagen production, cell mitosis, blood vessels growth, recruitment of other cells that migrate to the site of injury, and cell differentiation induction, among others. Nowadays in oral surgery there are two kind of platelet concentrates for in vivo tissue engineering applications: platelet-rich plasma (PRP) and platelet-rich fibrin (PRF). Platelet concentrates are a concentrated suspension of growth factors found in platelets, which act as bioactive surgical additives that are applied locally to induce wound healing.[10]

PRF was first used specifically in oral surgery by Dohan et al.[11] and is currently considered as a new generation of platelet concentrate. It consists of a matrix of autologous fibrin and has several advantages over PRP, including easier preparation and not requiring chemical manipulation of the blood, which makes it strictly an autologous preparation. For these considerations, in our study we preferred to use PRF procedure instead of PRP. The three-dimensional mesh architecture of PRF could release the growth factors slowly and accelerate the healing of both soft and hard tissues. The application of PRF could not only benefit the construction of osteogenic environment but also repair the regeneration of soft tissue in the treatment of immediate implant placement.[10]

Collagen can be synthetized by many specialized cells in the human body, depending on the localization; fibroblasts are responsible for collagen production in the connective tissue while osteoblasts for the bone. Collagen has many features, other than structural, including low immunogenicity, good hemostatic capacity, a chemotactic action on regenerative cells such as fibroblasts and osteoblasts and, lastly, good dimensional stability.

PRF will undergo quicker remodelling (biodegradation) in situ than a resorbable collagen membrane, but will also promote a strong induction on the periosteum/gingival tissue due to the slow release of growth factors and other matrix proteins.[12] In addition, PRF may act as a biologic adhesive to hold the particles together, facilitating the manipulation of the bone grafts.[11]

Mechanism of PRF to promote osteogenesis: -

Bone regeneration can be a complex process based on the interaction of osteogenic and angiogenic processes and the success of bone regeneration depends on the degree of vascularization of the bone defect area, especially of large scaffolds (Diomede et al., 2020). Adequate blood supply and neovascularization are necessary prerequisites for bone regeneration, especially in the early stages of bone regeneration, not only to provide nutrition and oxygen to the bone defect area

but also to support and regulate osteogenic activity at different cellular levels through structural pathways, and paracrine pathways (Grosso et al., 2017; Rather et al., 2019). During bone tissue formation, a variety of cells are often involved, such as mesenchymal stem cells, osteoblasts, and osteoclasts, among which, MSCs can regulate osteogenesis by activating ERK/MAPK, BMP-SMAD, TGF-β, Wnt, and Notch signalling pathways. The bone-forming activity of osteoblasts and the bone-resorbing activity of osteoclasts must be balanced for normal bone remodelling. PRF can regulate the above cells and has certain immunomodulatory and antibacterial effects, which can strongly promote the repair of bone defects.[12]

This case report discusses the prosthodontic rehabilitation of a patient with bone loss surrounding the implant **(**Fig:2) with placement of PRF along with bone graft incorporated with hydroxyapatite crystals.

The 6 months follow-up examination of 46 region revealed clinically healthy peri-implant soft tissues, no signs of complications such as bone loss, peri-implant infection or mucosal recession, and an overall pleasing treatment outcome. The periapical radiograph showed stable bone crest levels, with signs of minor bone remodelling at the alveolar crest.

CONCLUSION:

Today's understanding of bone science recognizes the pivotal role of growth factors in clinical bone grafting success. The result of the present case report is yet again a proof that the mechanism of action of the fundamental growth factors like PDGF and TGF-b in PRF exert a positive effect on bone regeneration. The amplification of PDGF and TGF-b through the technique of platelet sequestration and concentration into a platelet-rich fibrin is seen as an available and practical tool for enhancing the rate of bone formation and the final quantity of bone formed. The fact that PRF is an autologous preparation eliminates concerns about disease transmission and immunogenic reactions, which are associated with allogeneic or xenogeneic preparation, and about the possibility of mislabelling a sample, which might occur through a laboratory system.

In the present case report, it was shown that PRF that contains a concentration of platelets and a concentration of growth factors when used along with bone grafts produced a quantifiably enhanced result and showed a successful bone regeneration and thus can be employed as a method for treating peri-implant bone loss.

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CONFLICT OF INTEREEST: Nil

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