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REVIEW ARTICLE

Platelet Rich Fibrin (PRF) - A Novel Regenerative Material in oral and maxillofacial surgery - A LITERATURE REVIEW

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ABSTRACT:
The development of novel regenerative material to reduce inflammation and enhance healing process is one of the greatest task in clinical research. PRF (platelet rich fibrin) is an second generation platelet concentrate which has gained popularity in recent years due to its unique regenerative process. Platelet Rich Fibrin is completely autologous material with extended growth factor release compared to other growth concentrates. The standard quality and quantity of the fibrin matrix , leukocytes, platelets, and growth factors of PRF demands a standard protocol for preparation. The use of Platelet Rich Fibrin treatment has shown increased cellular proliferation, osteogenesis and mineralisation thereby enhancing wound healing capacity. Due to its versatility Platelet Rich Fibrin serves as workhorse in wound healing. This Review article attempts to encapsulate the technique, it's preparation and use of Platelet Rich Fibrin in the field of oral and maxillofacial surgery.

Key words: PRF (platelet rich fibrin), Autogenous material, growth factor.

INTRODUCTION:

Healing is an intricate process involving cellular organization, chemical signals, and the extra-cellular matrix for repairing the tissue. Platelets help in tissue haemostasis and wound healing. On activation of platelets, it releases growth factors that stimulate cellular growth, proliferation, healing, and cellular differentiation.[1] Development of Various bioactive surgical additives helps to regulate inflammation and increase the speed of healing process has been done.[2] One of the latest advancements in surgical dentistry is the use of platelet concentrates for in vivo tissue engineering applications. Platelet concentrates are of two types: (1) platelet-rich plasma (PRP) and (2) platelet-rich fibrin (PRF). These platelet concentrates are concentrated suspension of growth factors which act as bioactive surgical additives to induce wound healing when applied locally.[3]

In 1997, Whitman et al introduced [4], the use of PRP in surgical procedures. This proves the enhancement of cellular proliferation with risk of coagulopathies due to generation of antibodies against factors V, XI, and thrombin.[3] . In 2001 PRP was developed by Dohan et al.[2] and classified it as a second generation platelet derivative.

Unlike PRP, PRF is strictly a homologous fibrin matrix that consists of large quantity of leukocytes and platelets with a simpler preparation technique avoiding artificial or exogenous biochemical modifications such as anticoagulants or bovine thrombin or other jellifying agent usage.[5]

CLASSIFICATION OF PLATELET-RICH FIBRIN PRODUCTS:

According to the leukocyte content Dohan Ehrenfest et al.[6] classified PRF into two types:

i. Pure PRF or leukocyte-poor PRF
ii. Leukocyte-rich PRF or advanced PRF or Choukroun's PRF

BIOLOGIC PECULIARITY OF PLATELET-RICH FIBRIN:

PRF is a second-generation platelet concentrate that enhances the process of tissue healing. The elements of PRF include platelets, leukocytes, and fibrin matrix.[7] The biologic role of PRF in sustaining the healing mechanism has been summarized in (Flowchart 1.)

Flowchart 1: Role of PRF in healing of tissue:

The cytokines [8] involved in Platelet-rich fibrin are:

- Transforming growth factor-β [TGF- β]
- Platelet-derived growth factor [PGF]
- Vascular endothelial growth factor[VEGF]
- Insulin growth factor-1 [IGF-1]
- Fibroblast growth factor [FGF]
- Epidermal growth factor [EGF]

PROTOCOLS FOR PLATELET-RICH FIBRIN PREPARATION:

Dr. Choukroun gave a classical method for preparation of PRF . Now, PRF is prepared without using anticoagulant or bovine thrombin. The

standard quality and quantity of the fibrin matrix , leukocytes, platelets, and growth factors of PRF demands a standard protocol for preparation. The instruments used for PRF preparation includes a centrifuge, a blood collecting kit and 4-ml blood collection tubes. The patient's blood sample is collected in 4ml tubes that is devoid of any anticoagulant and is centrifuged immediately at a rate of 3000 rpm for 15 min.[9] To decide the success and clinical outcome of PRF, the time lapse parameter between blood collection and centrifugation is important. On centrifugation of blood, blood contacts the test tube wall, leading to activation of platelets and initiates the coagulation cascade. The resultant product consists of 3 layers: the uppermost layer of acellular platelet-poor plasma, middle layer of PRF clot, and red blood cells (RBCs) at the bottom of the test tube. The formed fibrin clot is collected from the test tube and the remaining RBCs that are attached to it are discarded [FIGURE 1]. The fluid is then squeezed to get a PRF membrane.[6]

FIGURE : 1 PRF

USES OF PLATELET-RICH FIBRIN IN ADVANCED SURGICAL DENTISTRY:

PERIODONTAL REGENERATION

Growth factors application promotes periodontal regeneration and healing. The use of PRF in the treatment of intrabony defects has shown clinical benefits. Yuchao et al.[10] proved that the PRF used as the sole grafting material seems to be an effective modality of regenerative treatment in case of periodontal intrabony defects. PRF serves as a resorbable membrane for guided bone regeneration, to prevent migration of nondesirable cells into bony defect and provides a space allowing the immigration of osteogenic and angiogenic cells, and permitting the underlying blood clot to mineralize.[11] Simonpieri et al proposed the concept of "natural bone regeneration".[12] which includes regeneration of gingival tissue and bone volume through PRF membrane [FIGURE 2].

FIGURE 2: PRF Placed inside extracted socket for socket preservation

SINUS LIFT:

To increase the residual bone height of the posterior edentulous maxilla a sinus floor elevation technique is used . In 1980s Boyne and James[13] performed sinus augmentation with autogenous bone grafts by the lateral window technique then it is later developed by Tatum et al.[14] PRF is used in sinus lift procedures in two ways, either as fragments mixed with different bone substitutes such as autogenous bone, graft, xenogeneic, allogeneic, and some other artificial materials or as sole filling material.[15]

GINGIVAL RECESSION:

The most predictive plastic procedure is coronally advanced flap procedure, with subepithelial connective tissue. Recently, to improve the efficiency of the root coverage treatments and reduce the morbidity of the techniques, PRF has been used along with conventional surgical procedure.[16] As reported by Aroca et al.,[17] the use of PRF membrane shows an increase in the width of keratinized gingiva at the test sites at 6 months compared to the modified coronally advanced flap alone.

PERIO-ENDO LESIONS:

Perio-endo lesions are developed either by periodontal lesion spreading apically with an already existing periapical lesion or by an endodontic lesion combining with an existing periodontal lesion. If it is chronic in nature, the prognosis of a true combined perio-endo lesion is often poor or even hopeless. The prognosis of affected tooth can be improved by increasing the bony support through bone grafting and guided tissue regeneration and the application of polypeptide growth factors to the surgical wound.[18] El-Sharkawy et al.[19] suggested, the PRF administration along with methods of tissue regeneration for the repair of intrabony defects, furcations, and periapical cystic cavities.

OTHER CLINICAL APPLICATIONS:

Other possible applications of PRF such as:

- To upgrade healing in the donor site.
- For revascularization of pulp and dentinogenesis of a necrotic tooth.
- To preserve alveolar ridge height after multiple teeth extraction.
- After transalveolar extraction.
- Acts as an adjuvant to healing of orofacial fractures.
- For regeneration of peri-implant bone.
- Reconstruction of Bone with large surgical defects after oral cancer therapy
- To fill the defects created after cystic pathologies removal.
- Acts as an additive for healing promotion after ablative surgical treatment of oral mucosal lesions.
- For volumerization of tissue.
- For the articular cartilaginous defects of temporomandibular joint treatment.
- In bone replacement procedures, mineralized PRF can be used.
- Used in localized osteitis.
- Used for protecting bone grafted area in cleft lip and palate surgery, even when proper closure cannot be obtained.

ADVANTAGES OF USING PLATELET-RICH FIBRIN:

Advantages [20] related to the use of PRF:

1. Efficient technique and Simplified preparation.
2. Accelerates Grafted bone healing rate.
3. It is available through blood sample
4. Manipulation of blood is minimal.
5. It can be used alone or in combination with other grafts.
6. It avoids the addition of external thrombin thus abstain the risk of immunological reaction.
7. When used with bony grafts, it is quick and economical when compared with recombinant growth factors.

DISADVANTAGES OF USING PLATELET-RICH FIBRIN:

Some disadvantages [20] as follows:

1. The final amount available is very less.
2. The blood collection time and its conveyance for the centrifuge affects PRF success rate.
3. Glass-coated tube is needed for clot polymerization
4. PRF is very difficult to store.
5. Dehydration leads to shrinkage and alteration in structural integrity of PRF so that its immediate use after preparation is demanded.
6. PRF manipulation requires clinical experience.

CONCLUSION:

Various experimental as well as clinical results favour the use of PRF alone or in association with other biomaterials, without conflicting findings. It shows successful outcome both in medical as well as dental fields with numerous advantages and indications. However, some of its uses, especially in dentistry, should be explored higher with more clinical uses, especially for the treatment of large oral cancers. In recent scenario, PRF seems to be minimally invasive technique that comes with minimal risk factors and satisfactory results clinically.

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