

Review Article

STICKY BONE: BOON TO REGENERATION A REVIEW

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ABSTRACT:

Platelets are known to release several growth factors Platelet Derived Growth Factors (PDGF) which help in tissue regeneration. Platelet concentrates are a boon in surgical field such as Platelet Rich Plasma (PRP) and Platelet Rich in Growth Factors (PRGF) for prevention of haemorrhage and acceleration of tissue regeneration. The former two belong to first generation of platelet concentrates. The second generation includes Platelet Rich Fibrin (PRF) and Concentrated Growth Factor (CGF). Incorporating these two growth factors with bone graft matrix using autologous fibrin glue has lead to the formation of "**sticky bone**".Sticky bone contains a rich fibrin matrix containing growth factors, thereby accelerating tissue healing process, stabilizing the bone graft in the defect and minimising bone loss during healing. This article presents the method of preparation of sticky bone and its clinical implications. **Keywords-** sticky bone, regeneration, bone graft

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INTRODUCTION

Extensive alveolar bone loss in periodontal disease leads to an increased demand of bone regeneration and reconstruction. In order to do so, numerous techniques utilising platelet concentrates have been introduced. Platelet releases growth factors such as Platelet Derived Growth Factor (PDGF), Transforming Growth Factor β -1(TGF β -1), Epithelial Growth Factor (EGF), Insulin Growth Factor-1 (IGF-1) and Vascular Endothelial Growth Factor (VEGF). These growth factors help in cellular proliferation and angiogenesis thereby accelerating tissue regeneration.^[1]

The various platelet concentrates are as follows:-First generation-

- 1. Platelet Rich Plasma(PRP)- PRP is defined as an 'autologous concentration of platelets in a small volume of plasma.^[2] PRP in combination with autogenous bone grafts has resulted in a faster rate of radiographic bone maturationand higher bone density as compared to bone grafts alone. It has been used in cases such as sinus floor elevation, alveolar ridge augmentation, treatment of periodontal defects and extraction sockets.^[3]
- 2. Platelet Rich Growth Factor (PRGF)- PRGF is formed by mixing particulate bone powder and bovine thrombin. Calcium Chloride is added to obtain fibrin polymerization. Anitua's plasma rich in growth factors is obtained by using kits such as placon (Oscotec Co, Chuman Korea), Smart PReP (Curasan PRP kit). Second generation-
- 1. Platelet Rich Fibrin(PRF)- PRF was first developed in France by Choukroun et al.^[4]It is developed from patients own venous blood(8-10 cc) which is collected in a tube coated with silica without any chemical anticoagulant. This tube is then centrifuged at 2,700 rpm for 12 minutes and the red cell layer is then discarded. The remaining platelet-poor plasma undergoes second spin and platelet with fibrinogen is obtained. This fibrin clot or platelet rich fibrin can now be easily collected from the tube.
- 2. CGF- Sacco's concentrated growth factors utilizes altered centrifugation forces ranging between 2,400- 2,700 rpm to achieve a much larger, denser and richer growth factors fibrin matrix.^[1]



Fig 1: A structured and resistant fibrin clot in the middle of the tube, just between the red corpuscles at the bottom and acellular plasma at the top following centrifugation.

Depending upon their fibrin and leukocyte content PRP is further classified into-P-PRP-Pure Platelet Rich Plasma (such as cell separator PRP)

L-PRP- Leukocyte and Platelet Rich Fibrin (such as Choukroun's PRF).^[5]



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PREPARATIONS OF "STICKY BONE"

Sticky bone is prepared by using CGF membrane and fibrin glue.^[1] Fibrin glue is a physiologically relevant matrix composed of fibrinogen and thrombin. Fibrin plays a fundamental role in blood clotting and wound healing. Fibrin stabilizing f actor XIII is present in fibrin glue. This factor favours the migration of undifferentiated mesenchymal stem cells and enhances its proliferation.^[6] This Autologous Fibrin Glue (AFG)is taken with a syringe and mixed with particulate bone powder which undergoes polymerisation in order to produce a yellow coloured "STICKY BONE".^[1]



Figure 2: Red cap tube is silica coated showing three different layers after centrifugation. The uppermost layer is platelet poor plasma, the middle layer is fibrin buffy coat layer containing the concentrated growth factors. The bottom most layer is red blood cell layer. Yellow cap tube is non silica coated and shows two different layers. The upper layer is AFGlayer and the bottom layer is accumulation of red blood cell layer.



Fig 3: Sterilized metal storage box containing the CGF layer before compression.

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Fig 5: Yellow coloured sticky bone mixed with particulate bone powder and AFG.

On mixing this sticky bone with autologous thrombin in the RBC layer produces a red colour. This mixture fastens the autopolymerisation process very rapidly.^[1]

This coherent mass when placed in defects during healing gives rapid results.Best results are obtained if sticky bone is used with CGF membrane (prepared by compressing CGF membrane in a metal storage box).^[1]

DISCUSSION

Use of platelet aggregation was first developed by Choukroun's and Sacco. PRP and PRGF can stabilize the particulate bone powder well when compared to PRF/CGF. You et al reported that platelet rich fibrin gel has the ability to induce higher bone formation to implant contact when compared to platelet rich plasma in bony defects around dental implant.^[7]

Fibrin rich gel releases growth factors such as transforming growth factor, platelet derived growth factor and vascular endothelial growth factor, thereby accelerating new bone formation when mixed with bone graft.

PRF and CGF can be used as an alternative to barrier membrane during the placement of graft.

Guided Bone Regeneration is a well established technique using bone graft and barrier membrane for augmentation of deficient alveolar ridges. There are 4 basic biologic principles necessary for predictable bone regeneration i.e.

i) Primary wound closure ii) Angiogenesis iii) Space creation iv) Stability , as described by Wang et al in 2006.^[8]



In severe atropic cases, block bone is used for space maintenance, but this procedure has many disadvantages. Hence as an alternative to this block bone procedure, sticky bone was introduced in 2010.^[9] Sticky bone is biologically solidified bone graft in which the particulate bone grafts are entrapped in fibrin network. It is a stable, coherent mass which can be easily handled with a cotton plier. Sticky bone has numerous advantages such as-

- 1. It is mouldable and hence can be well adapted into different shapes according to the bony defect.
- 2. Fibrin networks entrap the platelet and leukocytes to release growth factors, thus accelerating bone regeneration and soft tissue formation.
- 3. Particulate movement is prevented and thus the volume of the bone is maintained during the healing period.
- 4. Biochemical additives such as PRP and PRGF are not required.
- 5. Soft tissue ingrowth into the sticky bone graft is minimised.^[1]

CONCLUSION-

Preparation of CGF membrane and sticky bone is easy and is an effective material for reconstruction of edentulous alveolar bony defects. It can serve both as a biological healing matrix as well as regeneration. However further clinical research work is necessary.

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