Case Report

ISSN 2639-9490

Oral Health & Dental Science

# Bone Regeneration with Platelet-Rich Fibrin Following Surgical Management of Periapical Lesion: Achieving Success in a Resource-limited Area. A Case Report

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**Received:** 25 August 2021; **Accepted:** 14 September 2021

**Citation:** Gbadebo SO, Oyediran AO, Egbe TA. Bone Regeneration with Platelet-Rich Fibrin Following Surgical Management of Periapical Lesion: Achieving Success in a Resource-limited Area. A Case Report. Oral Health Dental Sci. 2021; 5(4); 1-5.

## ABSTRACT

***Background**: Intra-oral bony defects following periradicular surgery have been documented to have high self-regenerating potential (especially when small). However, early permanent rehabilitation of tooth to function is important post-surgery. Thus, there is a need to enhance bone healing through regeneration due to the prolonged natural bone healing process. Many materials have been proposed and used but the Platelet-rich fibrin (PRF); a second-generation platelet with fibrin membranes enriched with platelets growth factors is an autologous material, easy to produce and a cost-effective way of regenerating bony defects.*

***Aim**: To assess and report the regenerative potential of PRF following periradicular surgery.*

***Methodology**: A case report of a 60-year old female who presented with a chronic periapical abscess in relation to the upper right incisors. A periapical pathology of 30mm in its widest dimension was present on the radiograph. Following root canal treatment, the patient had periradicular surgery to remove the apical cystic lesion. The bony defect was filled with autologous platelet-rich fibrin (produced through centrifuging of peripheral blood) to stimulate bone regeneration, and the tooth was reviewed for one year.*

***Result**: The one-year review post periradicular surgery showed good healing and bone regeneration.*

***Conclusion**: The report showed the use of PRF in regeneration of intra bony defect post degranulation of periapical lesion (after removal of cystic lesion) as an effective and cheap way of achieving regeneration.*

## Keywords

Apical bony defect, Bone regeneration, Endodontic surgery, Platelet rich fibrin.

## Introduction

The periapical lesion is a local response of bone around the apex of the tooth, which may be due to bacterial infection of the dental pulp following necrosis of the pulp tissue or extensive periodontal disease [1,2]. Successful endodontic treatment is measured by periaradicular healing of the pathology when present, completed with the regeneration of defective bone. The healing can be achieved with conventional non-surgical root canal therapy (NSRCT) or surgical means [1]. The periradicular lesions, which can be dental granulomas, radicular cysts, or abscesses [3,4], often resolve after NSRCT. However, Abramovitz [5] reported that 24.5% of the endodontic cases in his study required surgical intervention. Such surgical intervention may be necessary in selected cases which may include treatment-resistant infection in the canals, presence of cysts, presence of a foreign body, or extra-radicular infection [5].

Intra-oral bony defects following removal of the periapical lesion have a good potential to self-regenerate [6], but the healing process can be limited by factors such as the size of the lesion/extent of bony defect, presence or absence of bony walls, the healing environment, and many more [7]. Therefore, it is imperative that in situations where there are deficiencies with complete bone healing, especially when the defect is greater than 15mm in the widest dimension [4,7], regenerative tissues such as bone grafts and barrier membranes must be deployed to enhance bone regeneration for optimal healing of such defects [2]. Previous researches advocated the local application of hormones such as growth factors and plasma derivatives to induce bone regeneration and soft tissue healing. [7-9] Additionally, growth-enhancing substances like bone morphogenic proteins (BMPs), platelet-derived growth factor (PDGF), Platelet-rich plasma (PRP), enamel matrix proteins (EMD), and Platelet-rich fibrin (PRF) have been used to stimulate the healing and regeneration of bony defects. [8,9].

Platelet-rich fibrin (PRF) is a second-generation platelet concentrate developed in France by Choukroun et al. in 2001 [8]. It has fibrin membranes enriched with platelets and growth factors, and a fibrin network enmeshed with platelets, leukocytes, cytokines, and stem cells [8]. The PRF possesses significant potentials of slowly delivering platelet-derived growth factor (PDGF) for at least one week [9] and up to about 4 weeks [8]. The major attraction of PRF is the fact that it is easy to obtain, inexpensive, and can be added to other regenerative materials such as bone graft [10]. PRF is a new platelet gel therapeutic concept with a simple process of extraction, and with no artificial biochemical modification, as it requires blood sample collection without anticoagulant [11].

PRF has been used in various surgical procedures and clinical treatments, such as the field of plastic surgery and dermatology, periodontology and regenerative endodontics, due to its effects of promoting wound healing [12]. Furthermore, the use of PRF in regenerative endodontics has been compared with Platelet-rich Plasma (PRP), a first-generation platelet concentrate [13,14], and its use compared with or without bone substitutes [10].

However, there is dearth of information on the use of this autologous regenerative material, in the management of bone regeneration after periradicular surgery in Nigeria. Therefore, this case report aimed to give an account of the regenerative potential of PRF in management of an intra-oral bony defect as a result of periapical lesion following the degranulation of the lesion.

## Case Report

A 60-year-old female patient presented at the Conservative Dentistry unit of the Dental Centre, University College Hospital Ibadan with a complaint of discolored teeth and pus discharge in relation to the right maxillary anterior region. The patient gave a history of trauma of about forty years with recurrent swelling around the region. Her medical and dental histories were non-contributory.

On clinical examination, grade I mobility of teeth 11 and 12 was observed. Both teeth were discolored, slightly tender on vertical percussion, and gave no response on thermal and electric pulp testing. Examination of the head and neck and all vital signs were essentially normal. Radiographic examination revealed a well-defined radiolucency of about 2.4 × 3.0 cm around the apices of right maxillary central and lateral incisors with well-defined sclerotic margins (Figure 1).

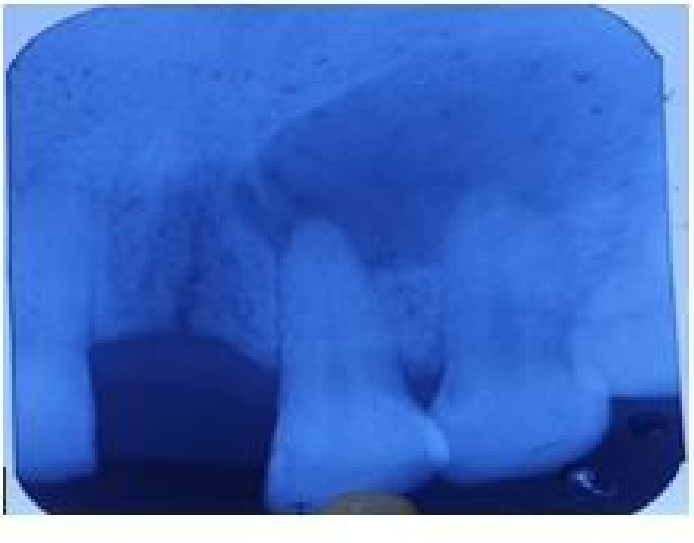

**Figure 1:** Pre-operative radiograph

Based on the clinical and radiographic findings, a provisional diagnosis of infected periapical cyst secondary to pulpal necrosis was made.

### Management

The treatment plan was root canal therapy of teeth 11 and 12 followed by periradicular surgery for surgical enucleation of the lesion, with subsequent regeneration of the residual bony defect using platelet rich fibrin. Informed consent was obtained from the patient to progress with treatment plan after due explanation, and the management was done in accordance with the Helsinki Declaration of the 1975, as revised in 2013 [15].

Following the standard protocol for root canal treatment, endodontic treatment was done prior the periradicular surgery. Surgery was done 2 days after completion of root canal treatment. The patient was prepared for surgery by routine cleaning and draping and anaesthesia was achieved with infiltration of 2% Lidocaine hydrochloride (Alphacaine 100 DFL). A 3-sided mucoperiosteal full thickness flap was raised, exposing a large bony window and the cystic pathology at the apex of the tooth (Figure 2).

The perforated bone was widened using a round bur on slow straight drill under water coolant to gain full access to the pathology. The cystic sac was enucleated as a whole, and sent for histopathological analysis. Afterwards, curettage was done and the apices of the teeth

were resected at 0-degree bevel. The root preparation was done to 3mm deep [7], gutta percha root canal filling was condensed and the root end was restored with Intermediate Restorative Material (IRM/Zinconol, polymer reinforced Zinc oxide eugenol cement, PrevestDenPro).

**Figure 2:** Periradicular lesion at the apex of teeth 11 and 12.

### Platelet Rich Fibrin (PRF) preparation

The fibrin clot (PRF) was prepared using the Choukroun's technique [8], by taking patient's blood sample form the cubital vein into 10 ml tubes with no anticoagulant. This was immediately centrifuged at 3000 rpm for 10 minutes in the laboratory. After centrifuging, three distinct layers were identified in the bottle.

- The supernatant at the topmost layer, representing acellular plasma /platelet-poor plasma (PPP)
- The fibrin clot (PRF) formed the second layer (Figure 3a)
- The exudates resulting from PRF clot corresponded to the solution trapped in the fibrin meshes

The PRF clot was then packed into the defect to completely fill the bony crypt (Figure 3b).

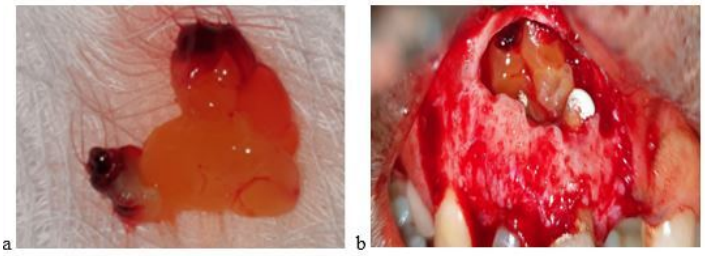

**Figure 3.** Shows the Platelet rich fibrin (PRF) clot (a) and the PRF placed in the bony crypt (b)

The flap was replaced and sutured in place with 3-0 vicryl. Post-operative radiograph was taken and instructions given. Patient was placed on nonsteroidal anti-inflammatory analgesics and broad spectrum antibiotics to prevent infection.

The patient was reviewed post-surgery for pain, (measured using Visual Analogue Scale (VAS)) and swelling after 24 hours and one-week post-surgery during which sutures were removed. Thereafter, further reviews were done at one month, 3 months, 6 months, and 1 year to assess healing and bone regeneration. Periodical radiographs were taken at the visits. (Figure 4).

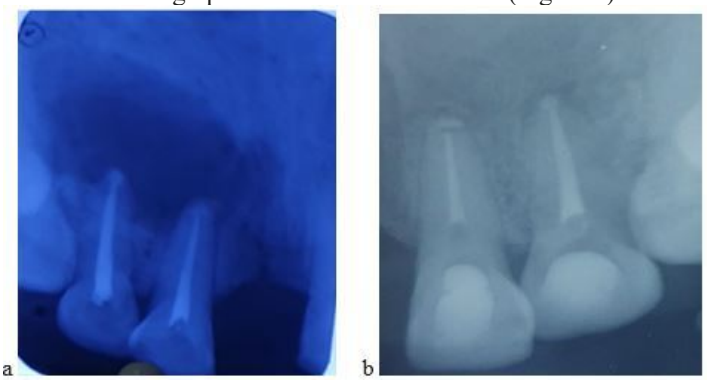

**Figure 4:** Shows Immediate post-surgery (a) and 1year post-surgery (b).

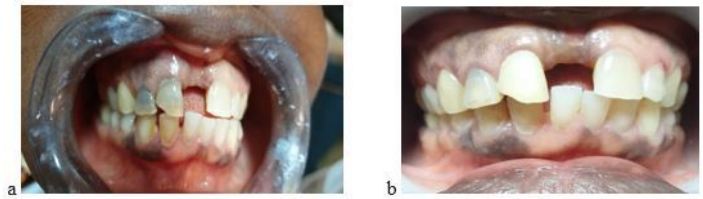

**Figure 5:** Teeth before (a) and after non-vital bleaching (b).

To restore the aesthetics, non-vital bleaching was done. Figure 5 shows the teeth pre-operative and post non-vital bleaching.

### Outcome

Follow up reviews at 24 hours and one week showed satisfactory soft tissue healing with no report of pain (VAS =0) nor swelling.

Bone regeneration was observed radiographically by six months, while by one year, satisfactory dense radiopacity indicating good bone deposit was observed in relation to the teeth 11 and 12 (Figures 4b).

## Discussion

Tissue regeneration is defined as reproduction or reconstruction of a lost, injured or surgically removed part such that the architecture and function of the lost, injured or removed tissues are completely restored [7]. Tissue regeneration in periradicular surgery means the regrowth of alveolar and peri-radicular bone, re-establishment of a periodontal ligament at the resection plane and at the surgically exposed root surface including formation of new cementum at the cut root-face [7].

Many methods of bone regeneration have been considered in the management of bony crypt formed as a result of periapical pathology. These include use of bone graft, auto graft, allograft and other regenerative materials/scaffolds like Platelet Rich Plasma [10,16-18]. Platelet Rich Fibrin is however, cheap, autologous, and with minimal or no risk.

In recent years, platelet-rich fibrin (PRF) has been considered suitable for oral and maxillofacial bone regeneration [4,5]. It is considered as the second generation of platelet concentrates because it is made by using a simplified protocol that includes centrifugation of autogenous peripheral blood without any biological agents, unlike the first generation of platelet concentrates, the platelet rich plasma (PRP) which is mainly produced by two-step centrifugation and addition of bovine thrombin and calcium chloride [6]. The PRF is a dense fibrin scaffold [8] composed of a fibrin matrix polymerized in a four-molecule structure, and it contains cytokines, platelets, leukocytes, and circulating stem cells [9].

Studies [13,14] that have compared PRP and PRF have shown PRF as a good and reliable method of regenerating bone. Additionally, being autologous reduces the risk of allergic reaction and rejection. The PRF is prepared naturally, without the addition of exogenous thrombin. It contains a natural fibrin framework that can preserve the growth factors, and prevent their proteolysis [18]. With a specific slow release of growth factors, the PRF is considered a natural fibrin-based biomaterial to guide cell migration into the wound. In addition, the growth factors are active for a relatively longer period and are effective in stimulating tissue regeneration [19], which makes PRF a biomaterial worthy of consideration for periapical tissue regeneration.

This report shows that the use of PRF without any other bone substitutes is effective, reliable and cost effective. This further makes platelet rich fibrin more advantageous in a resource-limited area where the other available bone substitutes are very expensive for the majority of patients. In addition, this case report has substantiated the ability of PRF alone to stimulate bone growth in the periradicular region. This result is unlike that of Zhao et al, [10] that used PRF in combination with bioactive glass but could not decipher which material was responsible for the bone regeneration.

Furthermore, there was no pain recorded as early as 24-hours post-surgery in this report. This is in accordance with the report of Anwandter et al. [20] that reported no pain post operatively, on use of PRF in extracted sockets.

Conclusively, the early return to function of tooth after periradicular surgery is important for both the functional efficiency of the tooth/teeth and psychology of the patient. This report has further established the effectiveness of using Platelet Rich Fibrin, (especially alone with no other bone graft), in returning a tooth that has undergone periradicular surgery back to function as early as possible due to its excellent ability in stimulating bone regeneration. Also, it is easy to prepare, cheap, and a reliable means of bone regeneration in resource limited setting.

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