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report

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Combination of platelet rich fibrin and carbonate hydroxyapatite alloplastic bone graft as periodontal tissue engineering in management of chronic periodontitis: a case report



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Abstract

Objective: Chronic periodontitis lesions include loss of attachment and bone and are regarded as irreversible. Conventional procedures cannot restore the periodontal tissue to its original form. Periodontal tissue engineering is regenerative medicine novel therapy by either implanting biomaterials. Platelet Rich Fibrin (PRF) as second generation platelet and Carbonate Hydroxyapatite (CHA) alloplastic bone graft can be used in surgical therapy because ease, inexpensive method and does not need any addition of exogenous compounds and a second surgical site and procedure. This case report aims to evaluate the clinical and radiographic effectiveness combination of both for the treatment of chronic periodontitis.

Methods: A 21-year-old female was reported with chief complaint tooth mobility. Initial examination revealed grade two mobility of 35 with 9 mm distobuccal and distolingual pocket depth. The Periapical radiograph revealed a large diffused periapical radiolucency in relation to 35. Periodontal surgery was done and the osseous defect was filled with CHA bone graft and PRF.

Results: There was a significant change in pocket depth and grade of mobility six months after surgery to 3 mm and grade one mobility. Radiographs showed resolution of an osseous defect.

Conclusion: It was concluded that combined PRF with CHA bone graft can be used to treat chronic periodontitis as simple technique periodontal tissue engineering.

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Keywords: Chronic Periodontitis, Tissue engineering, PRF, CHA, Bone Graft

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Introduction

Periodontal disease is a chronic inflammatory condition of the periodontium that is characterized by irreversible destruction.¹ Conventional treatments, guided tissue regeneration (GTR) and growth factors frequently cannot restore the periodontal tissue to its original form and usually cause aesthetic and functional problems.^{2,4}

Tissue engineering (TE) approaches have been recognized to combine a scaffold with living cells or biologically active molecules to form a "tissue-engineering construct", in the presence of adequate blood supply, promotes the repair or regeneration of tissues.³ TE described as a therapy replacing or regenerating human cells, tissues, or organs to restore or establish their normal function. The treatment components are often used in combinations; replace the missing portion of alveolar bone ("bone grafts"); cover the alveolar bone loss area, protecting it from epithelial down growth ("barriers"); and materials with biological activity that can be administered directly to the defect ("biologics" or "cell therapy").⁴ Recent developments in the science, technology, engineering, and mathematics (STEM)

arena allow for alternatives to address several challenges in the treatment of periodontal disease.⁵

Platelet Rich Factor (PRF) membrane release of key growth factors for at least one week and up to 28 days, an anti-infectious action and aid in immune regulation, promote angiogenesis and serve as a biological healing matrix by supporting cell migration and cytokine release.⁶ PRF has been used in dentistry in various clinical setting.⁷ Much investigation now supports the use of PRF for periodontal and soft tissue repair.⁸ Clinically significant improvements in periodontal parameters when infra-bony defects were treated with PRF alone when compared to open flap debridement.⁷ In addition to standard grafting procedures using bone-derived materials, a number of natural and synthetic materials have become commercially available for use in oral surgery.¹⁰

This case reported the used of periodontal bone grafting materials with carbonate hydroxyapatite (CHA) alloplastic bone graft as the scaffold in combination with PRF as bioactive molecules for a simple and low-cost method TE therapy.

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Case Report

A 21-year-old female was reported to Department of Periodontics Faculty of Dentistry Hasanuddin University, Makassar, Indonesia with chief complaint tooth mobility and calculus. Patient has a habit of chewing only on the right side. Initial examination revealed grade two mobility of 35 with 9 mm distobuccal pocket depth [figure 1](#) and 9 mm distolingual pocket depth. The Periapical radiograph revealed a large diffused periapical radiolucency reaching one-third of the tooth root 35. Scaling and root planing was performed and surgery was done a week later.

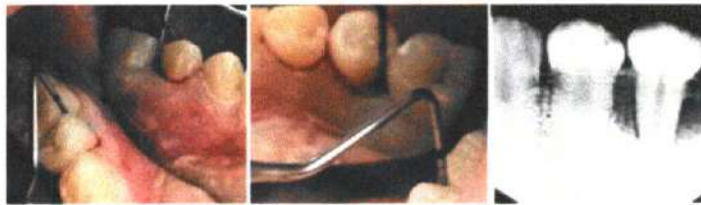


Figure 1 Initial examination



Figure 2 Surgical procedure



Figure 3 PRF & Bone graft

The intraoral antiseptics was carried out using iodine solution. A full thickness mucoperiosteal flap was reflected under local anesthesia by a sulcular then vertical incision [figure 2](#). Thorough tissue curettage was done at the defect site.

Preparation of PRF

The protocol for PRF preparation includes collection of 5 ml whole venous blood in each of the two sterile tubes without anticoagulant then placed in a centrifugal machine at 3,000 rpm for 10 min. There is three layers: Upper straw-colored acellular plasma (platelet-poor plasma), red-colored lower fraction containing red blood cells, and the middle fraction containing the fibrin clot [figure 3](#). The middle fraction is collected, 2 mm below to the lower dividing line, which is the PRF.⁸ PRF membrane should be used immediately after preparation as it will shrink, resulting in dehydration and altering the structural integrity of PRF. Dehydration also results in the decreased growth factor content in PRF and leukocyte viability will be adversely affected, altering its biologic properties.⁹

Bone defect was filled with Bone graft [figure 3](#) then applied PRF above it. The mucoperiosteal flaps were repositioned and secured in place by giving simple interrupted suture and a periodontal dressing was given [figure 4](#).

Postoperative instructions, amoxicillin 500 mg, ibuprofen 400 mg and 0.2% chlorhexidine gluconate rinses were prescribed. One week postoperatively, no gingival edema, erythema, suppuration, patient discomfort, or flap dehiscence.

Follow up six months after surgery showed significant improvement of clinical outcomes where the depth of the distobuccal and distolingual pocket was reduced to from 9 mm to 3 mm and grade mobility decreased from grade two mobility to grade one mobility.

Periapical radiography showed significant bone formation characterized by a decrease in radiolucency areas reaching a half of the root of the tooth 35 [figure 5](#).

Discussion

In general, tissue engineering combines three key elements, namely scaffolds (collagen, bone mineral), signaling molecules (growth factors), and cells (osteoblasts, fibroblasts).⁸ Natural or artificial scaffolds play an important role in growth factor storage and space maintenance for tissue reconstruction and in stem cell proliferation and differentiation.¹⁰

PRF is considered a second-generation autologous platelet concentrates inducing the proliferation, differentiation and migration of cells responsible

CASE REPORT

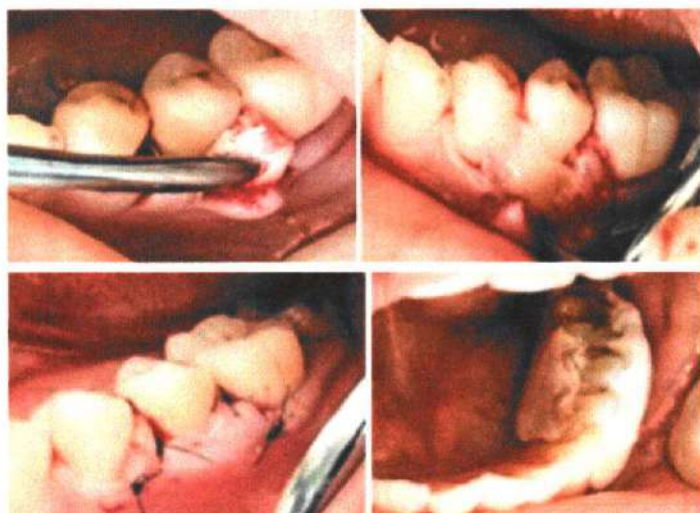


Figure 4 Application bone graft, PRF, Suturing and dressing



Figure 5 A week post surgery, Six months after surgery, Periapical radiography before and six months after surgery

for periodontal regeneration.¹¹ PRF consists of a fibrin matrix polymerized with the incorporation of platelets, leukocyte, and cytokines, and circulating stem cells with a specific slow release of growth factors and glycoproteins.¹² An intermediate layer after centrifuge called "buffy coat" or L-PRF where most leucocytes and platelets are concentrated that stimulates the local environment for differentiation and proliferation of stem and progenitor cells. It acts as an immune regulation node with inflammation control abilities.¹³

PRF membranes protect the surgical site; promote soft tissue healing; and when its fragments mix with graft material, it functions as a "biological connector" between the different elements of graft and acts as a matrix which supports neoangiogenesis, capture of stem cells, and migration of osteoprogenitor cells to the center of graft.¹⁴

Alloplastic do not provide any osteogenic cells or osteoinductive proteins, they are considered osteoconductive only.¹⁴ CHA has been proposed as an alternative material for bone regeneration not only due to its similarity to the mineral phase of calcified tissue, but mainly because this material may overcome limitations related to crystallinity and low solubility, and therefore extend the therapeutic capacity of HA. CHA more bioactive and soluble than Hydroxyapatite, contains nanostructured as well as a naturalized collagenized polymer which serves to accelerate the regeneration process of bone tissue, possesses osteoconduction, osteoinduction, and osteogenesis properties. CHA is a major component of human bones produced synthetically but identically (similarly and simultaneously) so as to avoid the immunological reactions.^{18,15}

Guided bone regeneration (GBR) principle inspired from GTR principle postulates that specific external additional cells are required to augment inhabiting cells so that new tissue regeneration can be accelerated. Osteoblast cells with ability to promote new alveolar bone remodeling are also required for GBR.²⁰

Conclusion

TE make cost-effective, patient-specific treatment options that provide maximal function and esthetics. PRF can be used in conjunction with CHA alloplastic bone grafts, which offers several advantages including promoting wound healing, bone growth and maturation, graft stabilization, wound healing and hemostasis, and improving the handling properties of graft materials.

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Conflict of Interest

The authors report no conflict of interest.

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