Case Report

Evaluation of Healing by Cone Beam Computed Tomography (CBCT) using Platelet-Rich Plasma (PRP) + β -Tricalcium Phosphate (β -TCP) and Platelet Rich Fibrin (PRF) + β -Tricalcium Phosphate (β - TCP) in Periapical Lesions: Case Report

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Abstract

When teeth have responded poorly to conventional endodontic treatment or when they cannot be treated adequately by nonsurgical means, surgical endodontics remains the treatment of choice. Healing of apical lesions occurs by repair, most of the time. "Repair is the healing of a wound by tissue that does not fully restore the architecture or function of the affected unit". Since this is not ideal, newer regenerative procedures that aim to restore lost tissue have been introduced. β -Tricalcium phosphate is an alloplastic bone graft material that forms a scaffold for closing the bony defect. It is osteoconductive. Platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) are platelet concentrates, rich in growth factors and they promote regeneration by osteoinduction. This article describes cases of bone augmentation with a combination of PRP + β -TCP and PRF + β -TCP for treatment of the chronic periapical lesion. The cases were followed for six months and one year and healing was evaluated quantitatively using cone beam computed tomography.

Keywords: β -*Tricalcium phosphate, cone beam computed tomography, platelet-rich plasma, platelet-rich fibrin*

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Introduction

Periapical lesions are the most common sequelae of microbial infection of the dental pulp. They generally present with acute pain and/or swelling in relation to the affected tooth or diagnosed during routine radiographic examination. All endodontic therapies are aimed to regain the state of health and function of the affected tooth. Most periapical lesions heal satisfactorily with non-surgical endodontic intervention. However, a few cases require periradicular surgery when symptoms and infection persist, to eliminate the source of infection and promote healing.

Traditional periapical surgical approaches include the debridement of apical lesions with reshaping of the surrounding bone. In such cases, healing is almost always by repair. Repair is defined as the healing of a wound by tissue that does not fully restore the architecture or the function of the lost tissue.[1] So attention has shifted towards regenerative approaches that aim to restore lost tissue.

Regeneration is the reproduction or reconstitution of a lost or injured part without any scar.[2] Various bone substitutes have been used after degranulation of the lesion, to achieve regeneration of the bone and optimal healing.

Beta-tricalcium phosphate (β -TCP) alloplastic bone graft material is one of these substitutes widely used

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to enhance new bone formation in periapical surgery. It is osteoconductive that gets chemically resorbed with a concomitant release of bioactive ions. However, beta TCP is osteoconductive but not osteoinductive and more time is required for replacement of this biomaterial with bone.[3]

The key to tissue regeneration is to simulate a cascade of healing events and promote integrated tissue formation. This is possible only with the use of biological modulators like the use of bone morphogenetic proteins, growth factors, and extracellular matrix because these induce regeneration by osteoinduction, which is provided by the various generations of platelet concentrates.

Platelet-rich plasma (PRP) is a first-generation platelet concentrate developed by Whitman in 1997, which is a rich source of growth factors and its application is thought to induce tissue repair and regeneration.[4]

Platelet-rich fibrin (PRF), the second-generation platelet concentrate developed by Choukroun in 2001, promotes periapical tissue regeneration and healing, being enriched with platelets and growth factors.[5]

PRF and PRP are now being widely used in diverse disciplines of dentistry. However, very few literatures are available on the use of PRF/PRP in combination with β-TCP in periapical bone defects.

Here, two such cases are presented where periapical surgery was performed and the bone defect was filled with PRP + β -TCP and PRF + β -TCP to promote bone regeneration and healing was evaluated quantitatively using CBCT.

Case Reports

Case report 1

A 23-year-old female presented with a chief complaint of pain and swelling in the upper front tooth region for the past one week with a history of on and off swelling for the past one year. Past dental history revealed trauma, which she sustained five years back in the same region. On examination, there was Ellis class I fracture in 11 with discoloration and tenderness. On electric pulp testing 11,12 showed a negative response. Periapical radiograph revealed a large diffused periapical radiolucency in relation to 11,12. The case was provisionally diagnosed as a chronic periapical abscess in relation to non-vital 11 12. Pre-operative CBCT scan was taken and the pre-op bone density values were recorded in Hounsfield Units (HUs) [Figure 1a and Table 1].

Under rubber dam isolation root canal treatment was initiated in 11,12. Calcium hydroxide (Metapex, Meta Biomed Co. Ltd., Korea) closed dressing was given.

Table 1: Pre-op and Post- op Hounsfield Unit (HU) Values

Case	Pre-op (HUs)	6 months (HUs)	1 year (HUs)
Case 1	2	635	1013
Case 2	33	622	1051

*Pre-op and 6 months and 1-year post-op bone density values recorded in Hounsfield Units (HU)

On subsequent visits, drainage was persistent in 11,12. Hence, it was decided to surgically debride the lesion after obtaining the patient's consent. Before the surgery, the patient's complete hemogram was done and all the parameters were found to be within normal limits.

11 and 12 were obturated under rubber dam isolation on the day of surgery, before start of the surgery. Intraoral and extraoral antisepsis was performed using 0.2% chlorhexidine digluconate rinse and povidone-iodine solution, respectively. Following administration of local anesthesia, crevicular incision was made using the Bard-Parker blade No. 15. Full-thickness mucoperiosteal flap raised from 13 to 22. After reflection of the flap and exposure of osseous defect, meticulous defect debridement was done [Figure 1e]. Root end was resected and the retrograde filling was done with Glass Ionomer Cement (GC Fuji IX). PRP was prepared before the surgical procedure in accordance with the protocol developed by Sonnleitner *et al*.

Ten milliliters of venous blood was drawn from the patient and transferred into two test tubes containing Ethylene diamine tetraacetic acid (EDTA) (Qualigens chem) as an anticoagulant. The blood was centrifuged (Remi-India) at 5000 rpm for 15 min. The blood and plasma were formed in two layers; the supernatant being plasma. The plasma was then aspirated with a pipette and transferred to a sterile test tube without an anticoagulant. The samples of plasma were subjected to a second centrifugation at 2000 rpm for 10 min, which allowed the precipitation of the platelets to fall onto the bottom, while the surface Platelet Poor Plasma (PPP) was discarded. The PRP was transferred to a dappen dish and stored at room temperature until further use. Just before placing the PRP into the bony defect, a small amount of bovine thrombin (Uniplastin, Tulip diagnostics (P) Ltd.) and a few drops of 10% calcium chloride (Thermo Fisher Scientific India Pvt. Ltd.) were added to the PRP to form a gel in a few seconds [Figure 1b]. PRP was mixed with β -tricalcium phosphate (Sybograf -T, Eucare pharmaceuticals (P) Ltd.) [Figure 1c, d] and placed into the intrabony defect up to the surrounding bone level [Figure 1f]. The mucoperiosteal flap was repositioned and simple interrupted sutures were given using 3–0 nonabsorbable black silk suture.

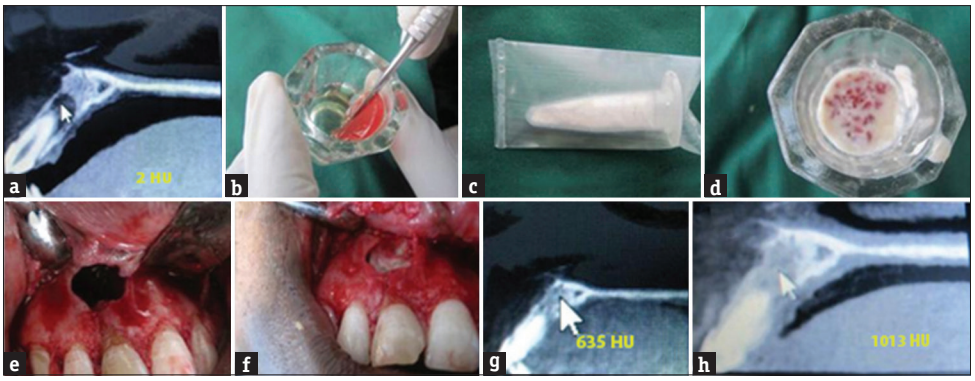

Figure 1: (a) Pre-op CBCT, 1b- PRP prepared, 1c- β - TCP, 1d- β - TCP + PRP, 1e- Peri apical curettage and root end treatment, 1f-β - TCP + PRP Placed in bone defect. 1g- CBCT after 6 months, 1h- CBCT after 1 year

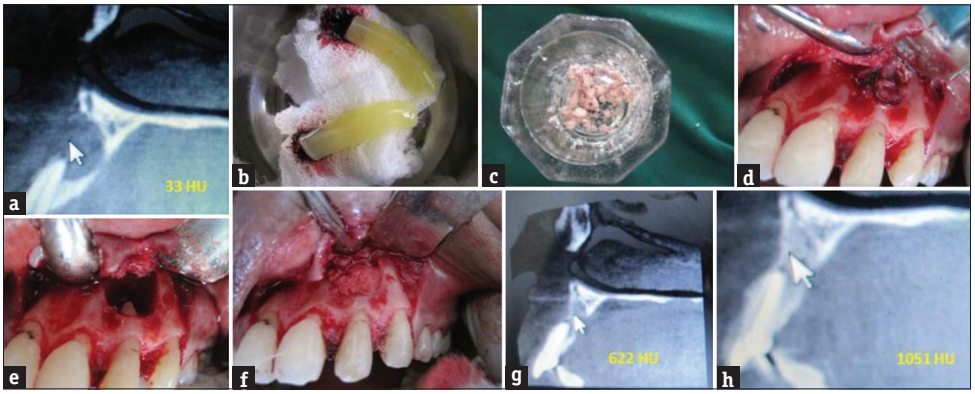

Figure 2: (a) Pre-op CBCT, 2b- PRF prepared, 2c- β- TCP + PRF, 2d- Mucoperiosteal flap reflected, 2e- Periapical Curettage and root end treatment, 2f- β - TCP + PRF placed in bone defect, 2g- CBCT after 6 months, 2h- CBCT after 1 year

Recall examinations were done after one month and three months for evaluation of oral hygiene maintenance and soft tissue healing and evaluation of bone healing at 6-months [Figure 1g] and 12-months interval [Figure 1h] were done using CBCT (Planmeca Helsinki, Finland) and the post-op bone density values were recorded in HUs [Table 1].

Case report 2

A 23 -year-old female reported to the Department, with a chief complaint of pain and swelling in upper front tooth region for past one week, with a history of on and off swelling for the past one year. Past dental history revealed trauma, which she sustained 12 years back in the same region. On examination, tenderness on percussion was elicited in 22. On electric pulp testing 22 showed a negative response. A periapical radiograph revealed a large diffused periapical radiolucency in relation to 22. The case was provisionally diagnosed as a periapical abscess in relation to non-vital 22. Preoperative CBCT scan was taken and the pre-op bone density values were recorded in HUs [Figure 2a and Table 1].

Root canal treatment was initiated in 22 and due to persistent drainage periapical surgery was planned. The same procedure was carried as described in case 1.

However, in this case, PRF was used to fill the bone defect. Full-thickness mucoperiosteal flap was raised from 11 to 23 [Figure 2d]. Periapical curettage was done, root end was resected, and the retrograde filling was done with Glass Ionomer Cement (GC Fuji IX) [Figure 2e]. PRF preparation was done before the surgical procedure according to the protocol given by Choukroun *et al*.[6] Intravenous blood was collected in a 10 ml sterile tube without anticoagulant and immediately centrifuged at 3000 rpm for 10 minutes to obtain PRF gel [Figure 2b], which was mixed with β -TCP [Figure 2c] and placed in the bone defect [Figure 2f]. Follow-up CBCT scan at six months and one year was taken and the post-op bone density values were recorded in HUs [Figure 2g, h and Table 1].

Discussion

Abramovitz *et al*. reported that treatment of 24.5% of the cases was not possible without surgical therapy.[6] Regeneration of tissue after periapical surgery requires recruitment of progenitor cell, signaling molecules, and local-micro environmental cues. Lack of any of these three elements would result in repair rather than regeneration. Various bone substitutes have been used

after degranulation of the lesion, to achieve regeneration of the bone and optimal healing.

β -TCP is one such synthetic bone graft material commonly used after periapical surgery. It is a bioactive material, biocompatible, immunologically inert, noncarcinogenic, nonteratogenic and resorbable. β -TCP is fully resorbed and replaced by vital bone over six months› time.[7] However, it is osteoconductive and not osteoinductive and more time is required for replacement of this biomaterial with bone.

Osteoinduction is a process where one tissue or its derivative causes another undifferentiated tissue to differentiate into a new bone and whereby new bone is produced in an area where there was no bone earlier. Among the rich sources of autologous growth factors, the various generations of platelet concentrates are currently in use.

In 1997, Whitman developed PRP, the first generation of autologous platelet concentrate. In 1998, Marx *et al*. reported the first clinical dental results with PRP and they suggested that PRP, when added to bone grafts, accelerated the rate of bone formation. The concentration of platelets obtained in PRP is 338% and contains concentrated growth factors to which the cells of the grafts are responsive and hence lead to faster healing.[8]

Choukroun in the year 2001, introduced platelet-rich fibrin (PRF), the second-generation platelet concentrate. PRF contains various growth factors such as PDGF, TGF- β 1, IGF, and they can regulate inflammation, provide a matrix, promote vascularization, and improve the healing of bone and soft tissue.[9,10] PRF preparation is easier, faster, and more simplified as compared to PRP, as it eliminates the need for the addition of anticoagulants.

Very few evidence is available in the literature regarding the use of platelet concentrates with β -TCP in periapical bone defects. The pre-op CBCT images revealed low bone density values in both the lesions. From the results obtained, there was a significant increase in bone density in both cases after six months and one year substantiating the bone regeneration accelerating potential of PRP/PRF when combined with a bone graft material like β - TCP.

Thus, considering the encouraging result of these case reports, platelet concentrates like PRP and PRF, in combination with β - TCP could be recommended as an alternative to bone grafts and membranes in extensive periapical lesions to enhance bone regeneration and to decrease the healing time.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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