Concentrated Growth Factor as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Case Report

AUTHORS:

Mahalakshmi Nandakumar, PG student, Department of Conservative Dentistry and Endodontics Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences,Saveetha University

Malli Sureshbabu Nivedhitha, Professor and Head of Department, , Department of Conservative Dentistry and Endodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University

Introduction

Periapical surgery is the treatment of choice for teeth with persistent apical periodontitis when the conventional non-surgical method fails to achieve the principal objectives [1]**.** It has been predicted that the smaller defect heals around one year, whereas for the larger defects, the healing time may be more than two years [2]. However recently, Lin et al have demonstrated that the healing of periapical tissues is a "programmed event". More than the size of the lesion it is the microenvironment consisting of the progenitor/stem cells, extracellular matrix and bioactive molecules that play a crucial role in tissue regeneration or scar formation during wound healing [3].

Concentrated growth factor (CGF) is a newer second generation platelet concentrate developed by Sacco in 2006.Differential centrifugation results in formation of a denser fibrin matrix richer in growth factors than those observed in PRF and PRP. This case report describes the exclusive role of CGF in healing of a large periapical lesion.

Case History and Examination

A 32 year old female patient was referred to Department of Conservative Dentistry and Endodontics with chief complaint of discolouration of upper right front tooth (tooth 11) for the past 6 months (Figure 1). .Past dental history revealed a traumatic fall 5 years ago for which no dental treatment was sought for. Intra oral clinical examination revealed slightly discoloured 11and chipping of the incisal edge with no presenting symptoms. Both 11 and 12 responded negatively to electric pulp tester

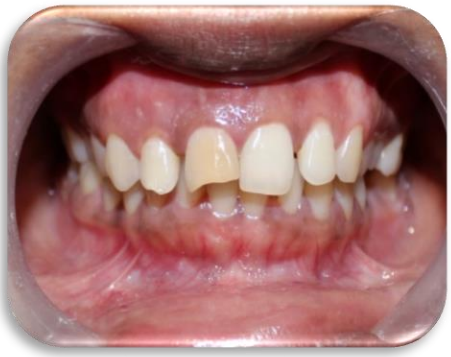

Figure 1: Preoperative Clinical

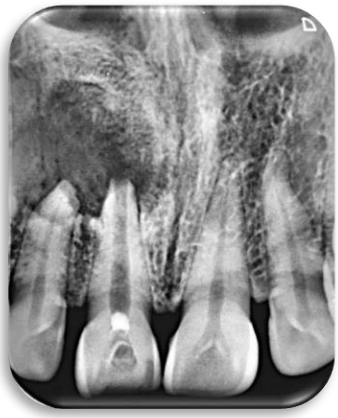

Figure 2: Preoperative Radiograph

On radiographic examination an extensive periapical radiolucency involving the roots of 11, 12 and an open apex of 11 were revealed (Figure 2). The pre-operative measurements of the lesion as seen in CBCT in different planes can be seen in Figure 3 and 4.According to the CBCT-PAI scores it was graded as 5D lesion [4].

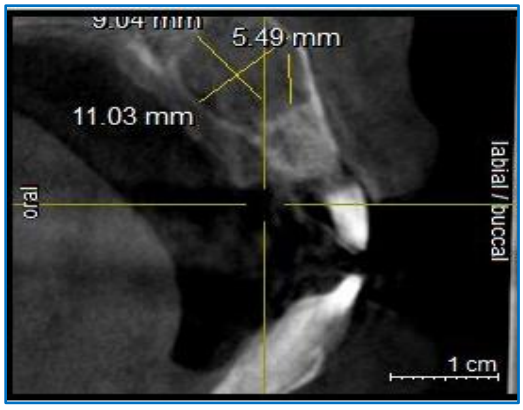

Figure 3: Preoperative CBCT in sagittal slice

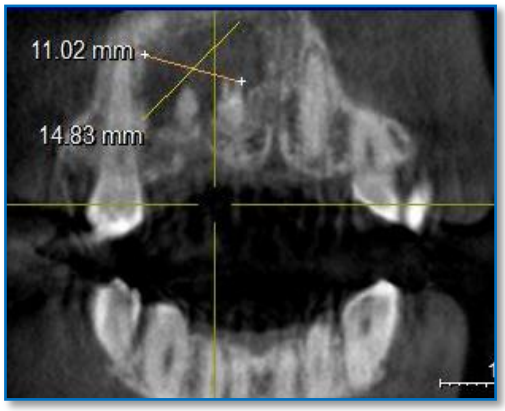

Figure 4: Preoperative CBCT in coronal slice

Diagnosis and Treatment plan

A diagnosis of Ellis Class IV fracture and open apex in 11 with apical periodontitis in 11, 12 was made. The treatment plan was root canal treatment for 11 and 12 followed by periapical surgery with use of

CGF. Periapical surgery was planned following the recommendation given by Spanish Society of Oral Surgery, (a radiotransparent lesion measuring over 8 to 10 mm in diameter). The patient was informed about the risks and benefits of the procedure and written consent was taken.

Case Description

Under local anaesthesia and rubber dam isolation, access cavity was prepared in 11 and 12 and working length was determined. Cleaning and shaping with copious irrigation using 3% sodium hypochlorite between each file, and final flush with 0.9% physiologic saline. Calcium hydroxide medicament was placed thrice for a period of 1 week each and were obturated a day before the surgery using custom made roll cone technique for 11 and conventional cold lateral compaction technique for 12 (Figure 5).

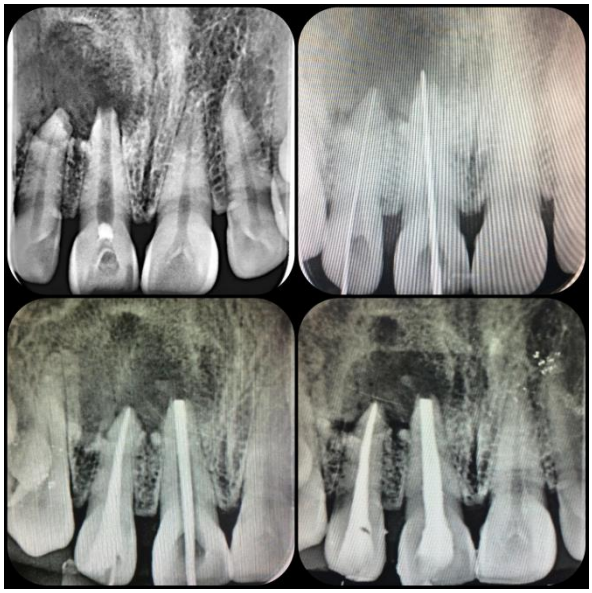

Figure 5: Working length, Master cone and Obturation of 11, 12

During surgery crevicular incision with a vertical releasing incision to reflect a full thickness mucoperisoteal triangular flap (Figure 6A). Cortical softening of periapical bone was noted from 11 to 13 region (Figure 6B). A bony window was created (Figure 6C) and thorough curettage was done (Figure 6D)

Apicoectomy was not done in 11 because of the presence of open apex (Figure 6E). Root end cavity preparation was done using zirconium nitride ultrasonic retro-tips in 11 and 12 and filled with Mineral Trioxide Aggregate (Figure 6F)

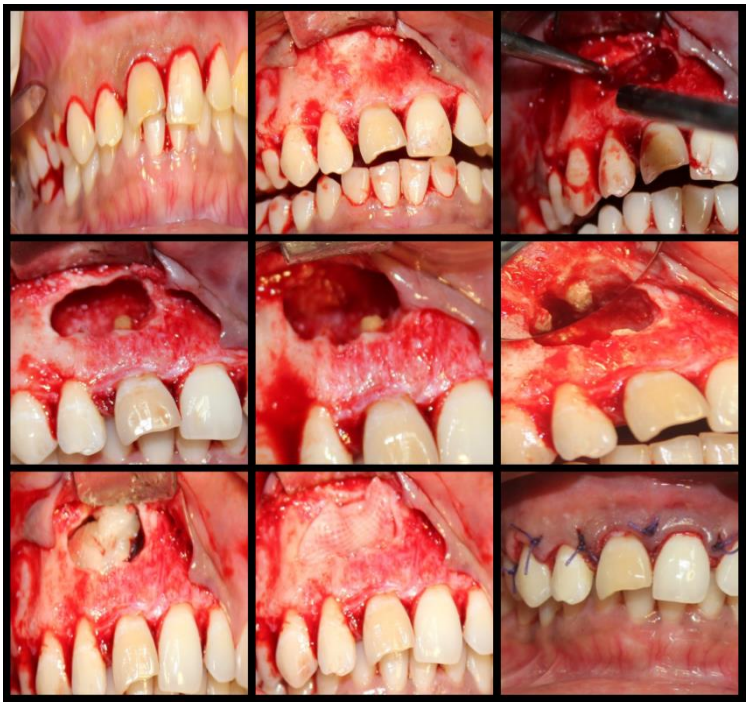

Figure 6: (A) Incision (B) Flap reflection (C) Bony window (D)Complete curettage of the lesion (E) Apicectomy done in 12. (F) Retrograde preparation and filling with MTA in 11, 12. (G) CGF fibrin block placed in the bony cavity. (H) CGF membrane placed to cover the bone defect (I) Suturing done

A standard, disposable, two 10-ml non-anticoagulant tubes and a matching centrifuge device (MEDIFUGE, Silfradentsrl, S. Sofia, Italy) were used. 20 ml of intravenous blood sample from the patient was placed in centrifuge tubes without anticoagulants and accelerated for 30 s, centrifuged at 2700 rpm for 2 min, 2400 rpm for 4 min, 2700 rpm for 4 min, and 3000 rpm for 3 min, and decelerated for 36 s to stop.

From the three layers formed, the uppermost platelet-deprived fraction was removed with a sterile syringe. The middle layer in the form of a membrane containing the concentrated growth membrane was held with a hemostatic clamp, separated from the RBC layer by using microsurgical scissors (Figure 7). It is then placed in a condensing disc and compressed to convert to CGF membrane (Figure 6G,H).

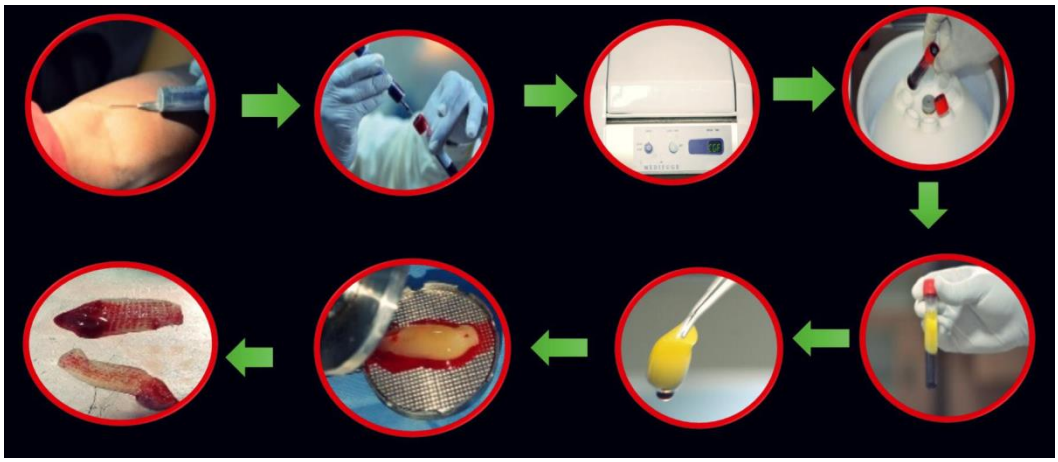

Figure 7: Preparation of CGF

Subsequent to CGF placement, flap was closed with 3-0 vicryl sutures (Figure 6I). The post-operative CBCT at 1 year follow up showed satisfactory healing with evident reduction in lesion size as shown in Figure 8 and Figure 9 and the patient was asymptomatic at all the recall periods, suggesting successful treatment outcome.

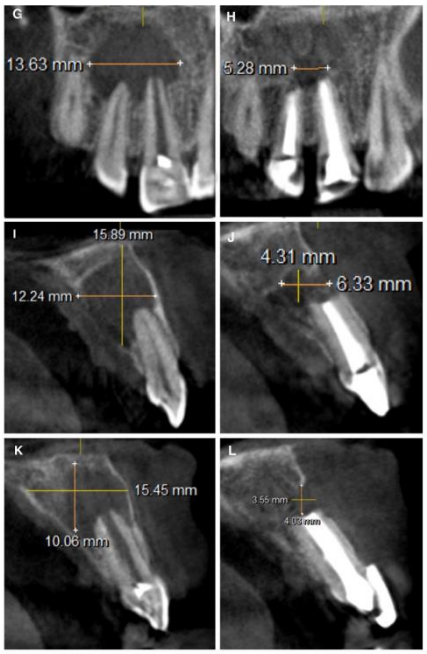

Figure 8: (G) Pre-op CBCT image showing the lesion measurement in the coronal slice (H) Post-op CBCT image showing the lesion measurement in the coronal slice. (I) Pre-op CBCT image showing the lesion measurement in sagittal slice corresponding to 12. (J) Post-op CBCT image showing the lesion measurement in sagittal slice corresponding to 12. (K) Pre-op CBCT image showing the lesion measurement in sagittal slice corresponding to 11. (L) Post-op CBCT image showing the lesion measurement in sagittal slice corresponding to 11.

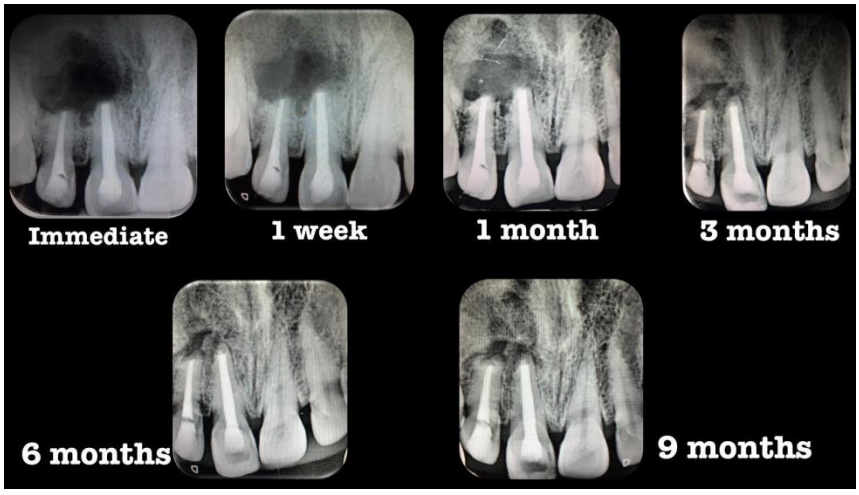

Figure 9: IOPA Follow ups at 1week, 1 , 3,6 and 9 months

Discussion

Our case report is unique in that CGF was produced using the recommended centrifuge and it was used as a sole material to understand its exclusive role in repair and regeneration after periapical surgery.

At 1-year follow-up with CBCT, Livewire segmentation using OSIRIX Version 9.5 (PIXMEO, Geneva, Switzerland) was done to delineate the lesion from healthy bone. Pre-operative and post-operative volume calculations were 0.7862 cm^3 and 0.08 cm^3 respectively. The lesion size reduction was found to be 89.2%(Figure 10).

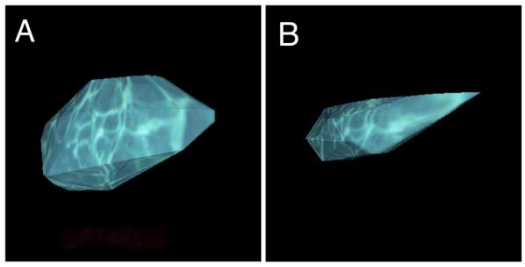

Figure 10: (A) Pre-operative volume calculation (B) Post-operative volume calculation

The centrifugation method for CGF is "pre-programmed" and the resultant CGF is stronger, thicker and abundant with growth factors. The centrifuge is equipped with self-ventilation that prevents the temperature rise which helps to maintain the viability of enmeshed cells in the fibrin matrix. The dense three-dimensional network of the fibrin ensures slow release of growth factors. Park et al affirmed that CGF consisted of thicker fibrinogen fibres per area unit and regular fibrinogen structures compared to PRF [5].

The presence of growth factors and leucocytes including also the few CD34+ circulating cells that are concentrate in a small volume are the probable reason for this success, since all the elements have been demonstrated to play an important role in vascular maintenance, angiogenesis and neovascularization. Park et al reported that TGF-β1 was released for one week whereas PDGF-BB for 3 weeks and identified that VEGF was one and half times more in CGF than PRF [5]. However, Qin et al showed that TGF-β1 had a slow release for 13 days [6] .Borsani et al have ascertained that CGF addition enhanced cell proliferation of fibroblasts, endothelial cells and osteoblasts which are involved in angiogenesis, tissue remodelling and regeneration [7].

There are two case reports in the literature which describe the utilization of CGF in periapical surgery. In the first, CGF was not prepared with the special centrifuge [8]. In the second, CGF was used along with sticky bone and Mphi laser [9]. The benefits of CGF are that it is autologous, can be easily prepared, cost effective than bone grafts and membranes in extensive. Taking into account the above benefits, CGF can be earmarked as an ingenious biomaterial for bone regeneration

Conclusion

Considering the encouraging result of these case reports, concentrated growth factor colud be recommended as an alternative to bone grafts and membranes in extensive periapical lesions to enhance bone regeneration and to decrease the healing time.

References

1. Ng Y-L, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature–part 1. Effects of study characteristics on probability of success. Int Endod J. 2007;40(12):921–939.

2. Archer WH. Oral and maxillofacial surgery. WB Saunders Company; 1975.

3. Lin LM, Ricucci D, von Arx T. Guided Tissue Regeneration in Endodontic Surgery: Principle, Efficacy, and Complications. In: Complications in Endodontic Surgery. Springer; 2014. p. 177–188.

4. Estrela C, Bueno MR, Azevedo BC, Azevedo JR, Pécora JD. A new periapical index based on cone beam computed tomography. J Endod. 2008;34(11):1325–1331.

5. Park HC, Kim SG, Oh JS, You JS, Kim JS, Lim SC, Jeong M, Kim JS, Jung C, Kwon YS, Ji H. Early bone formation at a femur defect using CGF and PRF grafts in adult dogs: a comparative study. Implant dentistry. 2016 Jun 1;25(3):387-93.

6. Qin J, Wang L, Zheng L, Zhou X, Zhang Y, Yang T, et al. Concentrated growth factor promotes Schwann cell migration partly through the integrin β1-mediated activation of the focal adhesion kinase pathway. Int J Mol Med. 2016;37(5):1363–1370.

7. Borsani E, Bonazza V, Buffoli B, Cocchi MA, Castrezzati S, Scarì G, et al. Biological characterization and in vitro effects of human concentrated growth factor preparation: An innovative approach to tissue regeneration. Biol Med. 2015;7(5):1.

8. Mirković S, \DJur\d jević-Mirković T, Puškar T. Application of concentrated growth factors in reconstruction of bone defects after removal of large jaw cysts: The two cases report. Vojnosanit Pregl. 2015;72(4):368–371.

9. Doan N, Nguyen-Pham L, Liang C, Duong QT. A review on the application of concentrated growth factors and MPhi laser to regenerate oral defects in the oral and maxillofacial region and a two cases report. Int J Oral Maxillofac Surg. 2017;46:203–204.

Contributor's Form

We certify that we have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data, as well as the writing of the manuscript, to take public responsibility for it and have agreed to have our name listed as a contributor.. We certify that all the data collected during the study is presented in this manuscript and no data from the case report has been or will be published by the editors, We attest that, if requested by the editors, we will provide the data/information or will cooperate fully in obtaining and providing the data/information on which the manuscript is based, for examination by the editors or their assignees..

We give the rights to the corresponding author to make necessary changes as per the request of the journal, do the rest of the correspondence on our behalf and she will act as the guarantor for the manuscript on our behalf.

All persons who have made substantial contributions to the work reported in the manuscript, but who are not contributors, are named in the Acknowledgment and have given us their written permission to be named.

Name	Signature	Date signed
1. Dr. MS Nivedhitha		1/3/19
2. Mahalakshmi N		1/3/19