Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v30i18.3387

TITLE: THE EFFICACY OF CONCENTRATED GROWTH FACTOR ON EXTRACTED TOOTH SOCKET WITH PERIAPICAL LESION- A CLINICAL AND RADIOLOGICAL STUDY

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Abstract

Background: Concentrated Growth Factor (CGF) in patients undergoing oral surgical procedures with periapical lesion serve as a stimulus for tissue repair, promoting bone and soft tissue recovery.

Aim: Determination of the effectiveness of concentrated growth factor on extracted tooth socket with periapical lesion is the aim of the following study.

Materials and methods: Case control Study conducted in 48 patients aged above 18 years old presented to the Department of Oral & Maxillofacial Surgery for extraction with periapical lesion was evaluated and the efficacy of CGF on extracted tooth socket with periapical lesion. Subjects were assigned into two groups - Group A (Case-CGF) and group B (Control – Conventional treatment.) and were evaluated postoperatively for pain, healing, and assessment of alveolar bone height.

Statistical analysis: Data analysis was done using the software Statistical package for Social Sciences version 26 and recorded as a Mean + Standard deviation.

Results: Pain index between two groups showed mean value in case group was less than control group. Assessment for post-operative soft tissue healing showed mean value for case group is greater than control group with excellent healing in case group. Width of alveolar bone measured at crestal, mid-root, and apical levels showed case group with good growth of alveolar bone evaluated with the control group.

Conclusion: CGF administration in extracted socket with persistent periapical lesions stimulates production of new bone with resolution of inflammation.

Keywords: Concentrated growth factor, periapical lesion, case control study, extracted socket, soft tissue healing.

INTRODUCTION

Periapical lesions are called as areas of inflammatory reaction due to the presence of pathologic agents on an infected root canal and are usually associated with loss of supporting bone. Often this can be corrected by an endodontic treatment such as root canal therapy (RCT), but if the infection is severe that antibiotics or endodontic treatment can not cure it, then extraction may be required to prevent the unfold of infection.

First-generation platelet concentrates namely Platelet-rich plasma (PRP) are related with limitations such as risk of coagulopathies, use of anticoagulants, handling aspects and price value, Concentrated Growth Factor (CGF) introduced by Sacco et al., 2006, have higher growth potential than Platelet-Rich Fibrin (PRF) due its rich and thick growth factor material content that promotes cellular proliferation, migration and in addition stimulates tissue remodeling at a quicker rate. [1] [2]

Growth factors are considered as the bioactive protein which regulate variety of cellular process, like cell division, with the potential to improve wound healing through several mechanisms and CGF is the novel and emerging second-generation autologous thrombocytes concentrate containing various growth factors.[3]

CGF contains VEGF helps in angiogenesis, PDGF in repair, IGF-1 for chemotactic activity and TGFb-1 for collagen synthesis and remodeling. CGF is also contains CD34+ stem cells, leukocytes, platelets that allows as well as supports for regeneration by its scaffolding property.[3]

CGF has been widely used to fill extraction sockets, to fill cavities after cystectomy, in implant surgery and sinus augmentation procedures. [4]

Centrifugation protocol for preparing CGF consists of different revolutions per minute (rpm) ranging from 2400rpm to 3000rpm with an aim of separating the cells in the obtained venous blood. The rationale of using CGF is that the presence of it can represent an additional stimulation for tissue healing that improves bone and soft tissue healing.

The main purpose of the current study is to determine the efficacy and effectiveness of CGF on extracted tooth socket with periapical lesion with the primary objectives to assess the concentrated growth factor efficiency the post-operative soft tissue healing the pain level bone healing and regeneration and to assess the infection rate.

MATERIALS AND METHODS

Study group

The following case control study was performed in a period of 2 months in those patients who reported to the unit for extraction of tooth with periapical lesion with poor prognosis for RCT, who are unwilling for RCT. The study included 48 healthy subjects under the American Society of Anesthesiologists (ASA) Classification category Class I aged above 18 years and non-smokers. The subjects were divided into two groups through a lot system as Group A (Case- Concentrated Growth Factor) and group B (Control – Conventional treatment). Before commencing the treatment, a radiograph for both groups were taken in order to assess the lesion size, pattern and to exclude the distinct periapical pathology. Due informed consent was taken from all participants included in the study. The study was approved by Institutional Ethics Committee and clearance certificate vide approval letter No: VDCW/IEC/313/2022.

Patients with bleeding and clotting disorders, ASA category patients of Class II, III and IV, Smokers, Poor oral hygiene, patients who underwent radiotherapy/chemotherapy, pregnancy/breastfeeding, distinct Periapical Pathology, anaemic and those subjects not willing for the study were excluded.

Preparation of CGF

Prepared based on Sacco protocol, about 9-10 ml of patient's blood were collected into a vacuum test tube and were centrifuged immediately without delay to avert coagulation in a specialized centrifuge device. The centrifuge was programmed such a way that acceleration was carried for thirty seconds thus it can attain an rpm of 2700 and rotated it for two minutes, then slowed down to 2400 rpm, then rotated it once more for four minutes and accelerated to 2700 rpm and rotated it for four minutes, the increased to 3000 rpm for three minutes, decelerated it for thirty six seconds to forestall and CGF gel was obtained [5].

Preoperative workup

A detailed case history of patients, including both the medical and dental histories was taken. Preoperative examination included the general conditions, routine blood tests and oral hygiene. Intraoral Periapical Imaging (IOPA) were taken to assess the lesion size, pattern and to eliminate the existence of retained apex of tooth, fragments of bone, and alveolus fracture. Immediate post extractions, Radiovisiography (RVG) were taken to fix the base line to measure the bone growth. [Figure 1]

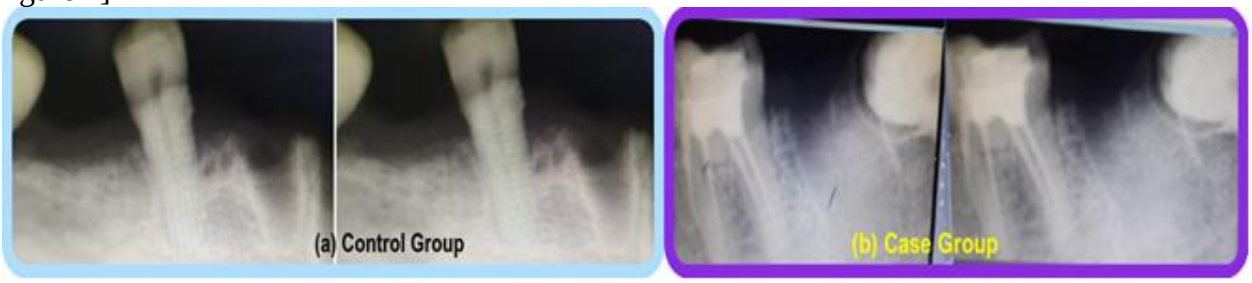

Fig 1 – RVG taken immediate after extraction of tooth for baseline.
(a) Image of control group radiograph
(b) Image of case group radiograph

Intraoperative procedure

The procedure was done by single operator. 2% lignocaine Local anaesthetics with a concentration of 1:80,000 adrenaline injected at the extraction site.

Group A (Case study group): Included 24 patients, who will undergo extraction and curettage followed by the socket irrigation with saline. After this Concentrated Growth Factor (CGF) was placed in the socket. No antibiotic and anti-inflammatory medication was provided. Only analgesics were provided if needed. [Figure 2]

Fig: 2 - CGF implantation of case group

Healing status of case group
(a) & (b) healing on 7th day
(c) healing status after 1 month

Group B (Control group): Included 24 patients, who will undergo extraction following periapical lesions under local anesthesia. After extraction, curettage was done followed by the socket irrigation with saline. thereafter, the patients were treated with antibiotics, anti-inflammatory and analgesics.

Outcome measurement:

"Day 0" is considered as the extraction day. The groups were then observed for pain score using Verbal Pain Intensity Scale ranging from “0” to “10”, in which “0” is considered as no/ absence of pain, 10 as worst pain possible. This was evaluated on a daily basis starting two hours after extraction. The pain score was assessed on the same time for seven consecutive days. Soft tissue healing was assessed using Landry Healing Index on day 1, 3, 5 and 7. Radiologically, the socket was recorded immediately after extraction, followed by 1st week and 2 months after extraction, using RVG to assess the lesion size and bone regeneration [6].

Height of the alveolar bone assessment carried out by using the RVG. Point A and Point B were marked respectively on two sides of the extracted tooth socket namely, mesial and distal. Reference line (AB) were constructed by connecting Point A and Point B from the Cemento-enamel junction (CEJ) of next adjacent teeth. Point C refers to the bottom most position on the alveolar ridge defect. To the line AB a perpendicular line was drawn from point C and the intersection point obtained as D. [Figure 3]. The distance of the point CD was measured at the following 7th day and 2-month follow-up visits. A millimeter graduated grid which is radiopaque was used as standardized assessment tool to measure the alveolar bone height radiographically across the extraction socket postoperatively. A reduction in the length of CD signifies an increase in bone height and vice-versa [7]. [Figure 4]

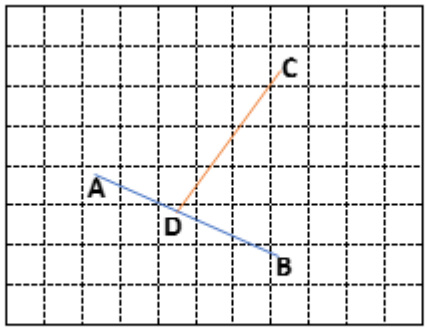

Fig: 3 Assessment of Postoperative radiograph (Illustration)

Fig 4 – Post Operative Radiographs
(a) Image of Control Group Radiograph
(b) Image of Case Group Radiograph

STATISTICAL ANALYSIS:

The data entered in Microsoft Excel subjected to statistical analysis using Statistical package for Social Science version 26 [8]. Quantitative data will be recorded as a Mean + Standard deviation. To analyze the data student-t test was used and carried for Pain index, Healing index and Bone growth index.

RESULT

The pain index was collected from the all the 48 samples (Both control & Case) on daily basis for 8 days (from day of extraction to day 7) and evaluated the progress for the following days of Day 0, 4th & 6th day. Day 0 is considered as the day of extraction, showed the mean value of case group is less than control group, which shows that the case group feels less pain when compared with control group.

Day 4 showed that mean value regarding case group is very less than control group, which shows that the case group feels less than mild pain as compared evaluated with the control group. Day 7 showed the mean value of case group is very less than control group, which shows that the case group feels no pain when compared with the control group.

Healing index were collected from all the 48 samples (Both control & Case) on a daily basis for the following 7 days (from day 1 of extraction to day 7). The extracted sockets were then assessed and evaluated for the following such as soft tissue healing on the Day 1, Day 5 & Day 7 respectively based on healing index known as the Landry healing index (color of tissues, bleeding on palpation and granulation tissue).

Day 1, the mean value of case group is greater than control group, which shows that the case group have good healing as compared to the control group at day 1. Day 5, the mean value of case group is greater than control group, which shows that the case group have better healing as compared to the control group and in day 7, the mean value of case group is 5 (scale 1 -5) and the control group is 3.13. The mean value of a case group is much greater than control group, which shows that the case group has excellent healing when compared with that of the control group. (Table – 1) (Fig 5)

TABLE – 1

HEALING INDEX

Day	Group	Mean rank	P value
Day 1	Group A	2.71	0.000
	Group B	1.00	
Day 3	Group A	3.58	0.000
	Group B	2.00	
Day 5	Group A	4.17	0.000
	Group B	2.92	
Day 7	Group A	5.00	0.000
	Group B	3.13	

PAIN INDEX

Day	Group	Mean rank	P value
*Day 1	Group A	5.42	0.000
	Group B	7.29	
Day 3	Group A	0.46	0.000
	Group B	2.67	
Day 5	Group A	0.04	0.000
	Group B	1.71	
Day 7	Group A	0.08	0.017
	Group B	0.42	

** Day 1 is the day of extraction in case of Pain index*

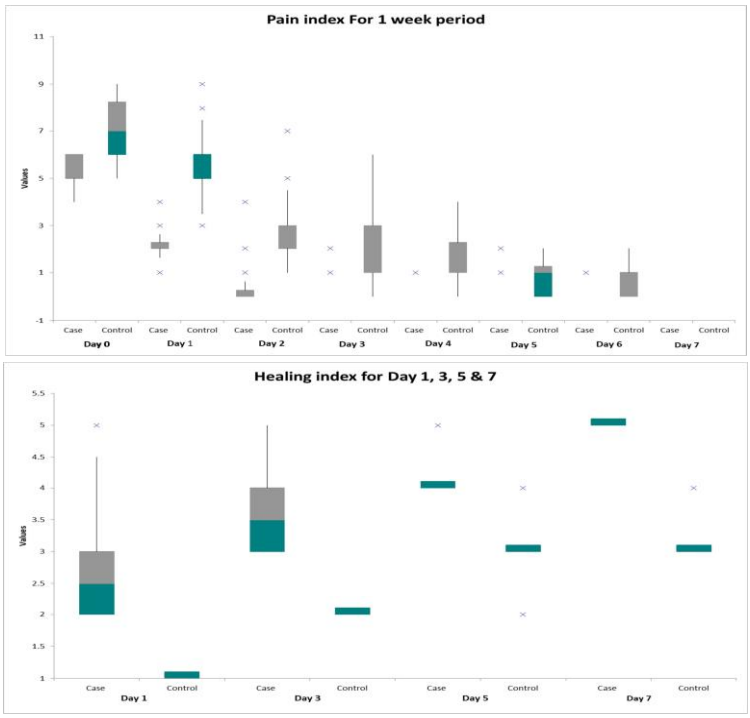

Fig: 5 Pain index & Healing index – Graphical representation

Assessment of alveolar bone height was carried by the RVG technique for baseline parameter for all 48 samples (24 in control & 24 in Case). Later was assessed for 48 samples (24 each) during 7th day and 4 samples from each group during 2 months later.

On evaluation a decrease in length of CD signified and depicted an increase in bone height and vice-versa. The mean value of case group is lesser than control group (the gap reduction ensures the larger bone growth), which shows that the case group have good growth in alveolar bone as compared to the control group. (Table – 2) (Fig 6)

TABLE – 2

GROWTH INDEX – (GAP)

Day	Group	Mean rank	P Value
Day 1	Group A	4.43	0.038
	Group B	4.22	
Day 7	Group A	4.37	0.039
	Group B	4.17	
Day 60	Group A	3.67	0.030
	Group B	4.06	

- ***Group A – Case (Patients who were treated with CGF***
- ***Group B – Control (Customary treatment group)***

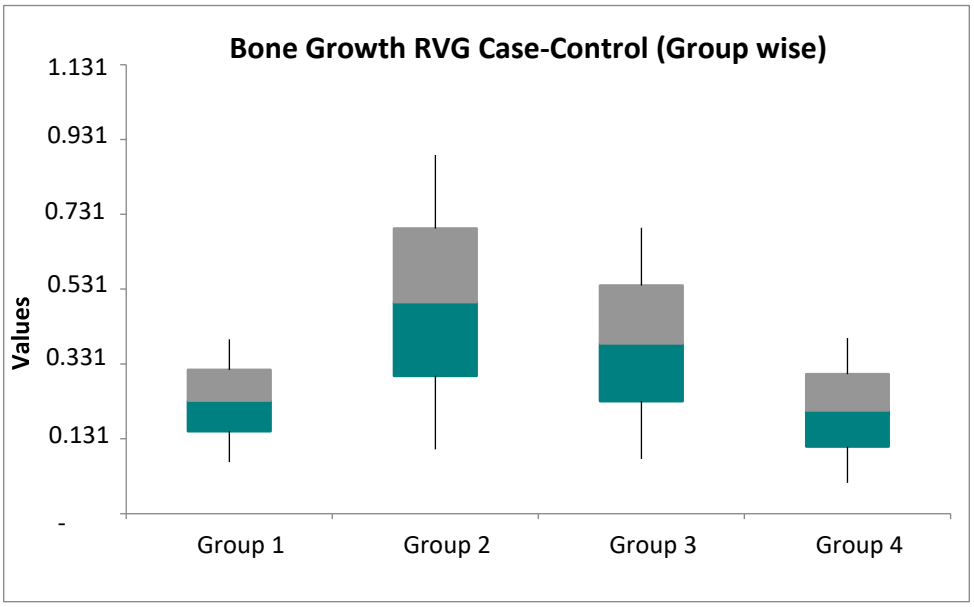

Fig: 6 Bone Growth index – Graphical representation

Thus, in customary Control group B (patients with conventional treatment), the pain score was observed as 6–10 on the day of treatment (presentation) (day 0) and the pain score fell to 3–4 on day 4 and further reduced to 0–2 on day 7 after treatment. Granulation tissue (GT) formation within the healing socket in Control group seemed obviously only on day 7.

In Case group A (patients who were treated with CGF), a similar score level (pain score) of 4–7 was recorded on the day of presentation (day 0), and drastically reduced to 0–1 on day 4 and furthermore enhanced to 0 on 7th day. The CGF applied sockets among group B patients in additional showed much earlier granulation tissue GT by day 4. By the 2nd week postoperatively, both control & case groups revealed similar pain score (After 7th day) and GT formation.

DISSCUSSION

A higher potency of the healing process is observed on treatment with CGF. CGFs are considered as ideal for clotting as it contains the following essential growth factor such as platelet-derived growth factor (PDGF), transforming growth factor (TGF), platelet factor interleukin (IL), vascular endothelial growth factor (VEGF), epidermal growth factor (EGF), insulin-like growth factor IGF, and fibronectin [9].

CGF supports angiogenesis, a crucial step in the healing of any wound, by encouraging cell migration and proliferation as well as controlling biological behavior [10].

Granulation tissue is considered as a layer of connective tissue which is formed on the surface of the wounds during the healing process, and it also forms a protective layer which is resistant to microbial invasion as it promotes formation as well as protects granulation tissue in a compromised wound. This could be one reason why CGF relieves pain and expedites healing in these patients.

Aqsa Kamal et al proposed in the year 2020 that CGF is third generation autologous platelet concentrate containing various growth factors along with blood cells.[1]

Banu Ozveri Koyuncu et al proposed in the year 2020 that CGF contains 3D fibrin network, acts as a scaffold and a reservoir in which the growth factors are closely bound together, thus it provides slow release of growth factors and this in turn helps in the process of wound healing.[4]

Nivedhitha Malli Sureshbabu et al proposed in the year 2019 that CGF is considered as a fibrin rich organic matrix which contains of platelets, leukocytes and CD34+ stem cells that helps in the process of regeneration.[5]

Marco Mozzati et al proposed in the year 2020 that CGF is an organic matrix which is rich in fibrin and hence forth is considered denser than the other platelet concentrates namely platelet rich plasma or the plasma rich fibrin.[3]

The purpose of present study is to determine the efficacy and effectiveness of CGF on extracted tooth socket with periapical lesion with the primary objectives to assess the concentrated growth factor efficiency the post-operative soft tissue healing the pain level bone healing and regeneration and to assess the infection rate.

Paired Sample t-test used to check the Pain index between two groups emphasized that the mean value of case the group was very less than that of the control group, which shows that the case group felt no pain as compared and evaluated to the control group.

Comparison of both the groups for the post-operative soft tissue healing, the bone healing and regeneration were assessed through the healing index according to Landry. The healing indexes were recorded for day 1, 3. 5 & 7. Paired Sample t-test was used to check the healing index between two groups. The mean value of case group was 5 and the control group was 3.13. The mean value of case group is greater than control group, which shows that the case group (CGF) had excellent healing as compared with that of the control group.

The results showed that there was statistically significant difference with the bone height between the Case group as well as the Control group at the baseline, 7th day, and the 2 months postoperative interval where ($P<0.05$), with added bone loss in the Control group when evaluated with the Case group. With the help of bone calipers the width of the alveolar bone was measured clinically at the following three levels namely the crestal, mid-root, and apical levels respectively. It was noticed that there was reduction in bone width after a period of 2 months in both Case as well as the Control extraction group. This reduction in width in Case group was about 1 mm less on evaluation than that in Control group. However, this difference was not found to be statistically significant ($P>0.05$).

This research is to assess the concentrated growth factor efficiency, to assess the post-operative soft tissue healing, to assess the pain level, to assess the bone healing and regeneration between the patients who are treated with antibiotics, anti-inflammatory and analgesics & the patients who are treated with the Concentrated Growth Factor (CGF) placed in the socket.

Application of CGF in an extracted socket with persistent periapical lesion may encourage the growth of new bones and the resolution of inflammation, greatly reducing the healing time. The success rate is increased while CGF helps to minimize postoperative discomfort at the early stages of recovery and the postoperative reaction. [Table 3]

TABLE – 3

Charecteristics Analysed	Case			Control			P Value	Result of Case group as compared with Control group
	η	Mean	Std Dev	η	Mean	Std Dev		
Pain Index	24	0.08	0.282	24	0.42	0.654	0.017	**Relatively no pain**
Healing Index	24	5.00	0.000	24	3.13	0.338	0.000	**Excellent healing**
Bone Height Growth index	4	0.596	0.241	4	0.065	0.038	0.015	***Better Bone growth

*** - Sample size is less due to limitation of research period (2 months). Larger samples will provide more clarity on this.

CONCLUSION:

All the results received prove to show that CGF is a valid aid in accelerating the methods of bone regeneration. Specially, the application of CGF in extracted socket with continual periapical lesions may stimulate the formation of new bones and the healing of inflammation, significantly shortening the recovery time. In the meantime, CGF assist to lessen postoperative pain at the early level of recovery and postoperative reaction thus increasing the success rate. Though the results look conclusive, further research period is required to investigate and analyze the RVG to attain more accurate detail about the element CGF and their overall performance on the Bone growth.

CONFLICT OF INTEREST:

No conflicts of interest

ETHICAL COMMITTEE APPROVAL & CONSENT TO PARTICIPATE:

The study was approved by Institutional Ethics Committee and clearance certificate vide approval letter No: **VDCW/IEC/313/2022.** Consent from all the patients was obtained through ***informed consent form.***

FUNDING:

Approved by ICMR for Short term studentship (STS) Program 2022. [Reference ID: 2022-02655]

ACKNOWLEDGEMENT

The authors gratefully acknowledge the Indian Council of Medical Research (ICMR) for providing the opportunity to gain research experience through their Short-Term Studentship program (STS).

Our earnest thanks to Dr. K. Saravanan (Head of Department), Oral and maxillofacial surgery, Vivekanandha dental college women for providing constant encouragement and guidance.

We owe a great deal to the members of the Department of Oral and Maxillofacial Surgery at Vivekanandha Dental College for Women for extending their support during the work.

We are grateful to Mr. Francis Dhanaraj & Mr. Ghulam Mustafa for their assistance in the analytical section using SPSS software.

Our heartfelt gratitude goes to Ms. Lalitha Subramani for providing the necessary information for this project.

We would like to thank Vivekanandha Dental College for Women, particularly Prof.capt. Dr. S. Gokulanathan (Dean) and Dr. N. Balan (Principal), for their kind permission and encouragement, which enabled us to complete this project successfully.

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