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Case Report

The Efficiency of CPRP and Blood Clots in Regeneration of Non-Vital Pulp Tissue in Teeth with Periapical Periodontitis Compared to Blood Clot Alone

Salma BA Abdo[1]*, Amera Alkaisi[2], Vanamala Parthiban[3], Aiman Hamad Al koubaisi[4] and Nouf Ali Salem Alharbi[5]

1Consultant Endodontist & Implantologist, Mediclinic Al Madar-AlAin, Abu Dhabi, UAE and AL NAJI University, Bagdad, Iraq

2Maxillofacial Specialist, Department of Dentistry, Al-Mashreq University College, Baghdad, Iraq

3Specialist, Family Medicine Midiclinic Al Madar-AlAin-Abu Dhabi-UAE

4Specialist Periodontist and Implantologist, Akil Clinic-Al Ain-Abu Dhabi-UAE

5Consultant Endodontist, Heathpoint- Abu Dhabi-UAE

***Corresponding Author:** Salma BA Abdo, Consultant Endodontist & Implantologist, Mediclinic Al Madar-AlAin, Abu Dhabi, UAE and AL NAJI University, Bagdad, Iraq.

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Abstract

Objective: The goal of this study was to compare concentrated platelet-rich plasma (cPRP) with a blood clot (BC) or a blood clot (BC) alone in the regeneration of non-vital pulp tissue in teeth with apical periodontitis clinically and radiologically.

Materials and Methods: Twenty-four children with an open apex and necrotic pulp with acute apical periodontitis were divided into two groups, A and B, and included in this study. On the first visit, the pulp chamber was accessed, a file loosely positioned 1 mm from the root apex, the canal was irrigated copiously with sodium hypochlorite using a needle positioned approximately 1 mm from the root apex, and the canal was dried. The canal was filled with calcium hydroxide as an intracanal medicament, and a glass ionomer was used for temporary restoration. The second visit started after 4 weeks. The canal was reopened, cleaned and dried. Bleeding was intentionally induced by using 25 files 2 mm beyond the apex into the canal. Then, cPRP gel was applied to the intracanal cementoenamel junction for Group A only. The canal was sealed with a 3-mm-thick layer of MTA, and the teeth were filled with composite for Groups A and B.

Results: SPSS version 26 was used for data analysis via the chi-square test, and a p value less than 0.05 was considered statistically significant. Within two years of follow-up, all teeth showed resolution of periapical radiolucency, continued root development with a positive response to the sensibility cold test and no discolouration in Group (A). In Group (B), 3 teeth failed

Conclusion: Our results confirmed the previous finding that cPRP with BC regenerates pulp tissue and is a better method for tissue engineering than BC alone.

Keywords: Blood Clots; Concentrated Platelet-Rich Plasma; Regenerative Endodontic Treatment

Introduction

Over the previous century, endodontic remedies have proven a high price of success in the retention of teeth; however, this is not continually possible. Many teeth remain un-restorable for countless reasons [1].

With increasing expertise in regeneration and dental tissue repair, techniques to develop lost or diseased dental tissue have been established and quickly entered into clinical practice to meet the demand for maintaining pulp vitality [2,3]. Endodontic regeneration has emerged as a novel therapeutic stage to promote regeneration in an extra predictable manner. It is an alluring clinical choice over traditional treatment [4].

The American Association of Endodontists and the European Society of Endodontology have stated the guidelines for regenerative endodontic procedures (REPs) in current years [5,6].

Three key components required for endodontic regeneration are the introduction of stem cells inside the canal space, suitable scaffold material, and growth factors. Additionally, it is fundamental to disinfect the root canal space [7,8].

The blood clot (BC) is commonly used as a scaffold and is created through deliberate overextended instrumentation of the periapical tissues, resulting in bleeding in the canal. Another option is to use blood drawn by venipuncture and injected into the canal space. Autologous fibrin matrices such as platelet-rich plasma (PRP) [9] and platelet-rich fibrin (PRF) [10] have been used as a choice or adjunct to blood clots (BCs).

Although blood clot regeneration (BCR) is the most common regenerative method, apical closure and the vitality of teeth may also manifest more often if concentrated platelet-rich plasma (cPRP) is used with BC as an alternative to BC alone for the regeneration of immature apical periodontitis teeth [11].

Platelet-rich plasma (PRP), an autologous first-generation platelet concentrate with a prosperous supply of growth factors, is a type of 3D fibrin matrix that helps entrap growth factors [9,12]. It is considered an alternative suitable scaffold because it has platelets that can exceed 2 million/μL, which is 5 times greater than the platelet count in natural human blood clots.

The goal of this study was to compare clinically and radiographically between two REPs, each with different scaffolds (BC) and (BC) with (c PRP), over a 2-year follow-up.

Materials and Methods

This clinical study was conducted in the Medicine Middle East with Health Point Hospitals from July 2021 to July 2023.

Twenty-four healthy children with a non-contributory medical history and immature permanent teeth with necrotic pulps and apical periodontitis were included. The study excluded medically compromised children and teeth with poor periodontal and restorative prognoses. The legal guardian was informed of the full course of treatment, potential results, and alternative treatment choices and signed the informed consent form.

The children were subsequently randomized into two treatment groups: Group A included 12 children who received regenerative endodontic treatment via concentrated plasma-rich platelets (cPRP) with a blood clot (BCR), whereas Group B included 12 children who received regenerative endodontic treatment via the BCR alone.

First appointment protocol

All 24 teeth were anaesthetized and isolated with a rubber dam. The access cavity was obtained, and the working length was established radiographically to be 1 mm shorter than the open apex. The canal area was irrigated gently with 20 mL of 1% NaOCl solution (Farmácia, Amazon, São Carlos, SP, Brazil). The necrotic tissue was removed. After that, 5 mL of sterile water was used for irrigation (Ranbaxy Laboratories, India). Next, paper points (Dentsply Maillefer, Ballaigues, Switzerland) were used to dry the canals. Then, calcium hydroxide paste (Calcicur; Voco GmbH, Cuxhaven, Germany) was added, and the entire canal space was coated to cement the enamel junction as an intracanal medicament. A coronal seal was obtained by using a glass ionomer (Ketac Cem; 3 M Espe, Seefeld, Germany) for four weeks.

Second appointment

A clinical examination was conducted four weeks following the initial appointment to rule out any moderate to severe sensitivity to palpation and percussion. The first visit's treatment is repeated if this kind of sensitivity is noticed, along with any sinus tract or swelling. As a result, we carried out the second part of the revascularization protocol.

Using concentrated platelet-rich plasma (cPRP) for Group A, using a conventional laboratory centrifuge (PasmaFill-DrPRP-USA), blood was drawn from the child and placed into sterile tubes containing 3.8% sodium citrate. The tubes were centrifuged for five minutes at a speed of 4,000 rpm to extract the PRP. The obtained fractions were then carefully separated with a 500 μL sterile pipette in a laminar flow chamber to isolate the PRP in the middle of the tube, which was different from the red blood cells at the bottom and the platelet-poor plasma at the top, which were transferred to the activator tube to obtain the cPRP gel. Then, the cPRP gel was transferred to a 10 mL hypodermic syringe to be injected into the canal. Adequate anesthesia was achieved via the use of 3% mepivacaine (Alexandria Pharmaceutical, Egypt) without a vasoconstrictor, and rubber dam isolation was performed. The access cavity was obtained, intracanal medicament was removed by using 20 mL of 17% ethylenediaminetetraacetic acid (EDTA) (Prime Dental, Mumbai, India), and the root canal space was dried by using paper points. Bleeding was initiated by using a sterile 25 K file (MANI Inc., Utsunomiya, Japan) 2 mm beyond the apex of the tooth, intentionally inducing bleeding into the canal. Once the blood clot

formed in the apical third of the canal space, cPRP gel was applied intracanal until it reached the cementoenamel junction. In addition, the entrance of the canal was sealed with a 3-mm-thick layer of Biodentine (Septodont, St. Maur-des-Fossés, France) mixed according to the manufacturer's instructions. Composite resin restoration was placed (Dentsply International, Milford, DE, USA) over the biodentine (Septodont, St. Maur-des-Fossés, France). While Group (B) was the same as Group (A), the canal space was filled with induced bleeding to below the cementoenamel junction without using cPRP.

Clinical and Radiographic evaluation [13]

The evaluation was performed every 6 months for a period of 24 months.

A-Clinical failure

If the tooth became tender to percussion and palpation, the fistula developed, discoloured and did not respond to Endo ice (cold test).

B- Radiographic failure

If the immature tooth remains with an open apex, the root's thickness and length remain the same, and the size of the periapical radiolucency either increases or remains the same.

Statistical analysis

SPSS was used for data analysis. The chi-square test was performed to determine the significance of the difference in regeneration ability between the cPRP + BC and BC groups. A value of alph < 0.05 was considered significant.

Results

Group A (cPRR + BC)

After nine months, 12 teeth showed a positive response to the Endo-ice sensitivity test.

The complete periapical radiolucency disappears when the roots of 12 teeth fully develop and enlarge in width and length. (Figure 1: a-d) every 6 months

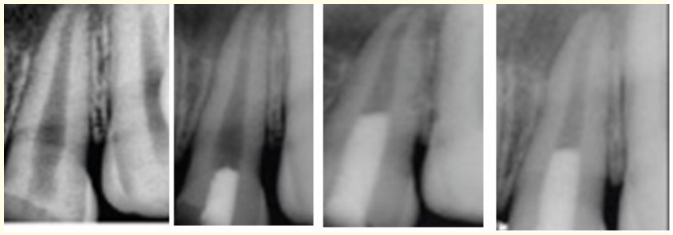

Figure 1

Group B (BC)

After 11 months, two teeth became discoloured (Figure 2), with the periapical radiolucency remaining the same size as at the beginning, showing no growth in the width or length of the teeth and a negative response (cold test). (Figure 3: a-d).

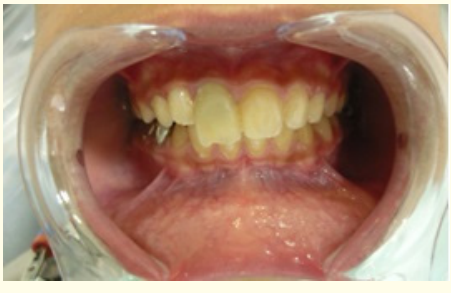

Figure 2

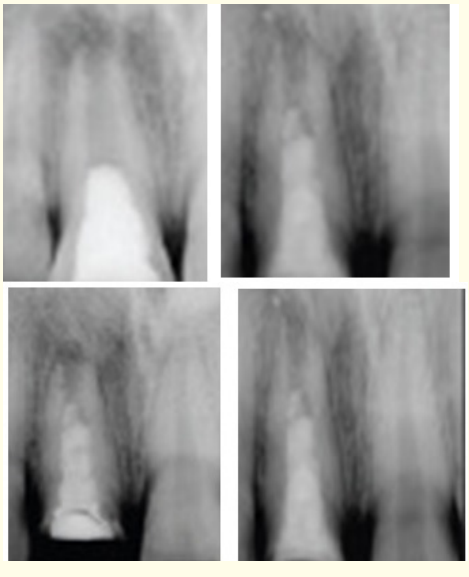

Figure 3

Until 2 years, one tooth remained unresponsive to the cold test; nevertheless, the periapical radiolucency disappeared, and the apex closed, with the width and length of the root increasing.

Statistical analysis results

There was a statistically significant difference between cPRP + BC and BC, P = 0.004 (Table 1).

Chi-Square	8.333[a]
df	1
Asymp. Sig.	.004

Table 1: Chi-square test showing the differences Between the PRP+BC and BC groups.

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.0.

Discussion

The treatment of necrotic immature permanent teeth has been very difficult and has compromised previously for the following reasons: first, teeth have immature root formations that are very fragile should fracture. Second, it is very difficult to disinfect and obtain the root canal space without extruding the irrigation solution or the filling material via the blunderbuss open apex [14].

In addition, when calcium hydroxide or MTA is used for specification, there is a slight increase in length of 6.1% without any increase in width, although the success rate is high (95%). However, the teeth remain fragile [15]. In our study, the success rate of PRP+BCR was significantly greater than that of BCR, which agreed with the findings of previous studies [16-18]. However, it disagrees with other studies [19,20].

Ostby identified the function of a blood clot in wound healing and its experimental application in endodontics as early as 1961 in his histological study involving a series of nine patients [21]. The blood clot serves as a scaffold for the ensuing development of tissue. Three cases of failure when the BCR was used as a scaffold were included in the current study. The cause might be bleeding from a laceration of the periapical tissues. It can be unpredictable, ranging from little to non-existent. In addition, numerous haematopoietic cells in the blood eventually die and release their toxic intracellular enzymes into the surrounding environment, which could be harmful to the survival of stem cells [22,23].

PRP was first used in regenerative endodontic procedures (REPs) in 2011. Since PRP is an autologous fibrin matrix, possesses many of the adhesion molecules needed for cell migration and is rich in growth factors, it has been proposed for REP as a substitute for BC [24]. In addition, haematopoietic cells, especially erythrocytes, which do not contribute to healing and often breakdown soon after being inserted, are also removed during the PRP preparation procedure. This explains the failure of only one patient in group (A).

In this study, three teeth in group (B) failed; in one of them, the root was completely formed, the periapical radiolucency disappeared, the dental wall thickness increased, and the response to the cold test was negative. In Group A, the response of 12 teeth to the cold test was successful. This contradicts previous studies' conclusions that both clinical and radiographic outcomes do not differ [25,26].

Furthermore, histologic studies have shown that PRP alone does not significantly affect RET results and that the tissues formed inside the root canals after the regeneration protocol with either BC or PRP are similar [27, 28]. Pulp generation and maturation with PRP confirmed a considerably quicker preliminary response to the vitality test than the BC group did, which may also indicate greater organization of the vital pulp tissue. The higher platelet concentration in PRP than in BC explains the greater potential for sensory fibre regeneration [29].

Conclusion

The use of platelet-rich plasma as a scaffold with focused micromolecules and growth factors indicated great periapical healing, root lengthening, dentinal wall width, and tooth sensitivity in necrotic immature permanent teeth over the blood clot.

More clinical and histological outcome studies on REPs are needed to identify whether any particular technique is better than the other technique.

Conflict of Interest

The authors of the manuscript declare that there are no conflicts of interest.

Bibliography

1. Nakashima M and Akamine A. "The application of tissue engineering to regeneration of pulp and dentin in endodontics". *Journal of Endodontics* 31 (2005): 711-718.

2. Yen A and Sharpe P. "Regeneration of teeth using stem cell based tissue engineering". *Expert Opinion on Biological Therapy* 6 (2006): 9-16.

3. Tziafas D., *et al.* "Designing new treatment strategies in vital pulp therapy". *Journal of Dentistry* 28 (2000): 77-92.

4. Young CS., *et al.* "Tissue engineering of complex tooth structures on biodegradable polymer scaffolds". *Journal of Dental Research* 81 (2002): 695-700.

5. AAE Position Statement: Scope of Endodontics: Regenerative endodontics". *Journal of Endodontics* 39 (2006): 561-563.

6. Galler KM., *et al.* "European society of endodontology position statement: Revitalization procedures". *International Endodontic Journal* 49 (2016): 717-723.

7. Bezgin T and Sönmez H. "Review of current concepts of revascularization/revitalization". *Dental Traumatology* 31 (2015): 267-273.

8. Galler KM. "Clinical procedures for revitalization: Current knowledge and considerations". *International Endodontic Journal* 49 (2016): 926-936.

9. Jadhav G., *et al.* "Revascularization with and without platelet-rich plasma in nonvital, immature, anterior teeth: a pilot clinical study". *Journal of Endodontics* 38.12 (2012): 1581-1587.

10. Keswani D and Pandey RK. "Revascularization of an immature tooth with a necrotic pulp using platelet-rich fibrin. A case report". *International Endodontic Journal* 46 (2013): 1096-1104.

11. Shivashankar VY., *et al.* "Comparison of the effect of PRP, PRF and induced bleeding in the revascularization of teeth with necrotic pulp and open apex: a triple blind randomized clinical trial". *Journal of Clinical and Diagnostic Research* 11.6 (2017): ZC34-ZC39.

12. Asmin PK., *et al.* "Dental stem cells in intraoral regenerative therapy: a systematic review". *Brazilian Dental Science* 25.2 (2002).

13. Li L., *et al.* "Clinical and Radiographic Outcomes in Immature Permanent Necrotic Evaginated Teeth Treated with Regenerative Endodontic Procedures". *Journal of Endodontics* 43 (2017): 246-251.

14. Cvek M. "Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta percha. A restrospective clinical study". *Endodontics and Dental Traumatology* 8 (1992): 45-55.

15. Jeeruphan., *et al.* "Mahidol study 1: comparison of radiographic and survival outcomes of immature teeth treated with either regenerative endodontic or apexification methods: a retrospective study". *Journal of Endodontics* 38 (2012): 1330.

16. Pinto N., *et al.* "An innovative regenerative endodontic procedure using Leukocyte and Platelet-rich Fibrin associated with apical surgery: a case report". *Journal of Endodontics* 43 (2017): 1828-1834.

17. Murray PE. "Platelet-Rich Plasma and Platelet-Rich Fibrin Can Induce Apical Closure More Frequently Than Blood-Clot Revascularization for the Regeneration of Immature Permanent Teeth: A Meta-Analysis of Clinical Efficacy". *Frontiers in Bioengineering and Biotechnology* 6 (2018): 139.

18. Tang Q., *et al.* "Are platelet concentrate scaffolds superior to traditional blood clot scaffolds in regeneration therapy of necrotic immature permanent teeth? A systematic review and meta-analysis". *BMC Oral Health* 22.1 (2022): 589.

19. Ulusoy AT., *et al.* "Evaluation of Blood Clot, Platelet-rich Plasma, Platelet-rich Fibrin, and Platelet Pellet as Scaffolds in Regenerative Endodontic Treatment: A Prospective Randomized Trial". *Journal of Endodontics* 45.5 (2019): 560-566.

20. Ríos-Osorio N., *et al.* "Comparative outcomes of platelet concentrates and blood clot scaffolds for regenerative endodontic procedures: A systematic review of randomized controlled clinical trials". *Journal of Clinical and Experimental Dentistry* 15.3 (2023): e239-249.

21. Ostby BN. "The role of the blood clot in endodontic therapy. An experimental histologic study". *Acta Odontologica Scandinavica* 19 (1961): 324-353.

22. Petrino JA., *et al.* "Challenges in regenerative endodontics: A case series". *Journal of Endodontics* 36 (2010): 536-541.

23. Nosrat A., *et al.* "Regenerative endodontic treatment (revascularization) for necrotic immature permanent molars: a review and report of two cases with a new biomaterial". *Journal of Endodontics* 37.4 (2011): 562-567.

24. Salma A and Amera Al. "The ability of platelet-rich plasma to regenerate anon-vital immature permanent teeth". *Brazilian Dental Science* 24.3 (2021).

25. Bezgin T., *et al.* "Efficacy of platelet-rich plasma as a scaffold in regenerative endodontic treatment". *Journal of Endodontics* 41 (2015): 36-44.

26. Ramachandran N., *et al.* "A comparison of two pulp revascularization techniques using platelet-rich plasma and whole blood clot". *Journal of Conservative Dentistry* 23 (2020): 637-643.

27. Martin G., *et al.* "Histological findings of revascularized/revitalized immature permanent molar with apical periodontitis using platelet-rich plasma". *Journal of Endodontics* 39 (2013): 138-144.

28. Zhu W., *et al.* "Regeneration of dental pulp tissue in immature teeth with apical periodontitis using platelet-rich plasma and dental pulp cells". *International Endodontic Journal* 46 (2013): 962-970.

29. Ulusoy AT., *et al.* "Evaluation of blood clot, platelet-rich plasma, platelet-rich fibrin, and platelet pellet as scaffolds in r Endodontic treatment: A prospective randomized trial". *Journal of Endodontics* 45 (2019): 560-566.