

Effect of platelet rich fibrin barrier and bioceramic sealer in endodontic treatment immature teeth with periapical lesions

Hien Thuc Huu Huynh

hhthien@ump.edu.vn

University of Medicine and Pharmacy at HoChiMinh city

Khanh Quoc Nguyen

National Hospital of Odonto-Stomatology

Khoa Pham

University of Medicine and Pharmacy at HoChiMinh city

Short Report

Keywords: PRF, bioceramic sealer, periapical lesion

Posted Date: August 6th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10479093/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Version of Record: A version of this preprint was published at BMC Research Notes on September 22nd, 2026. See the published version at <https://doi.org/10.1186/s13104-026-08033-9>.

Abstract

Objectives

Evaluate the clinical and radiographic outcomes of endodontic treatment using PRF apical barrier and bioceramic sealer for immature teeth with periapical lesions after 1,3,6 months.

Methods

In this cases report, platelet-rich fibrin (PRF) membrane were used as an apical barrier combined with a bioceramic sealer and gutta percha cone in root canal obturation for 15 permanent teeth with open apex and periapical lesion in 14 patients in the National Hospital of Odonto-Stomatology HoChiMinh city (10 teeth in male and 5 teeth in female, age from 7 to 14 years old). The clinical symptoms and radiograph variables were collected at the time of before and after treatment 1, 2, 3 and 6 months.

Results

All 15 cases had successful clinical outcome without any clinical symptoms after treatment. During the follow-up time, the size of periapical lesions reduced gradually and significantly. All the periapical lesions were completely healed at the time of 6 months re-examination.

Conclusion

Using PRF apical barrier combined with bioceramic sealer in endodontic treatment for immature permanent teeth with periapical lesions showed both favorable clinical and radiographic outcomes.

Introduction

Immature permanent teeth can be damaged by dental caries, trauma, abnormalities... leading to pulp necrosis and periapical lesions. These lesions were characterized by chronic periapical inflammation, radiolucency, and impaired root development [1]. Because the functional and aesthetic role of these teeth in very young patients, biologically conservative treatment approaches were essential to preserve their structure and potential for continued development [2].

Endodontic treatment of immature teeth was really challenging due to the dental structure was underdeveloped with open apices, short root length, and thin dentinal walls. Conventional obturation techniques may increase root fracture risk [1, 3]. Apexification using calcium hydroxide required multiple visits over months and was associated with an increased incidence of root fracture [2, 4, 5]. Recently, biomaterials and tissue regeneration techniques have been applied in endodontics that offer faster healing. Bioceramic sealer has gained popularity due to its excellent sealing ability, bioactivity, and capacity to promote hard tissue formation [6]. However in cases of immature teeth, the absence of a natural apical stop increased the risk of sealer extrusion. The placement of an apical barrier before obturation was needed to control material placement.

Platelet-rich fibrin (PRF), introduced by Choukroun, was a second-generation autologous platelet concentrate containing leukocytes and a fibrin matrix rich in growth factors. These biomolecules stimulated angiogenesis, osteogenesis, and soft tissue repair [7, 8]. In endodontics, PRF has been increasingly used as a biologically active matrix to promote healing and serve as an apical barrier in necrotic immature teeth [9].

While previous studies have documented favorable outcomes using bioceramic sealer or PRF in isolation, limited data exist on their combined use. This case series aimed to report the clinical and radiographic outcomes of endodontic treatment in immature permanent teeth with periapical lesions using bioceramic sealer in combination with platelet-rich fibrin (PRF) as an apical matrix barrier.

Materials and Methods

Fifteen necrotic single-rooted permanent teeth with open apices and periapical lesions of 14 patients in the age of 7 to 14 years old were included in this clinical cases report. The clinical examination and treatment were conducted from July 2023 to June 2024 at the Department of Endodontics and Pediatric Dentistry, National Hospital of Odonto-Stomatology in Ho Chi Minh City, Vietnam.

Patients were screened through clinical examination and periapical radiography to get baseline data—including demographic information, clinical findings, and diagnostic imaging. After that, the patients were treated as the following protocol.

Endodontic treatment protocol. Pulp access was achieved under rubber dam isolation. In cases of swelling or pain, local anesthesia was administered using 2% lidocaine. Working length was determined using the apex locator and confirmed radiographically. The canal was under gentle preparation and limited irrigation using 2.5% sodium hypochlorite, followed by saline. Each canal was dressed at least one week with calcium hydroxide and sealed temporarily with glass ionomer cement.

The patients were scheduled for follow-up visit in one week. If the patient reported no symptoms (fistula, swelling, pain), the tooth was re-examined by removing calcium hydroxide using hand files and irrigate with saline, 17% EDTA and saline in turn. The root canal was dried using sterile paper points to evaluate for obturation.

If there was still a fistula or swelling and pain or the canal was not dry at the time of re-examination, calcium hydroxide would be reapplied weekly until the symptoms resolved. In case the root canal could not be dried after 4 weeks, the tooth was excluded from the study.

The obturation was performed under local anesthesia with 2% Lidocaine and rubber dam isolation. Place PRF into the root canal to the correct working length with an appropriate vertical compaction instrument to create the apical barrier, and filling the root canal with bioceramic sealer (Bio-C® SEALER, Angelus, Brazil) and warm gutta-percha under the endodontic microscope.

The PRF was created followed Choukroun protocol by centrifuging 10 ml of venous blood from the patient at 1300 rpm for 8 minutes using a centrifuge machine (Duo Quattro, Process for PRF®). The centrifuge force at the bottom of the test tube is RCFmax=208g (RCFmin=113g, RCFav=164g, RCFclot=145g). Using laminator PRF (A-PRF) to create PRF membrane and sterile scissors to cut it into small pieces.

A periapical radiograph was taken to check for complete filling canal and the tooth was filling with glass ionomer cement. The treatment process was illustrated in Fig. 1.

Re - examination and outcome assessment

Patients were called daily in three day after obturation to find out any discomfort symptom. Patients were asked to describe their level of pain by the ordinal scale (no pain, mild pain, moderate pain, severe pain, and the worst pain imaginable). Patients would be invited to return the hospital for re-examination and medication if the pain were moderate or more.

At the first re-examination (7 days post-obturation), patients were examined for clinical symptom included spontaneous pain, pain on percussion, swelling, pus discharge. The access cavity was also permanently restored with composite at this visit.

The following re-examination were scheduled at 1, 2, 3 and 6 months later. All follow-up data were systematically recorded using the same data collection form. Periapical digital radiographs were taken using parallel technique with a silicone lock to measure the size of periapical lesion.

Clinical success was defined as the absence of pain, swelling, pus discharge, or tenderness on percussion in the treated tooth or adjacent area. Clinical failure criteria was defined as the presence of any of the abovementioned symptoms.

Since, the size of the periapical lesions were not normally distributed, the non-parametric Mann–Whitney U test was used. The alpha significant level was set at 5% ($P \leq 0.05$) and a 95% confidence interval (CI).

Ethical Considerations. The study was approved by the Ethics Committee for Biomedical Research of the University of Medicine and Pharmacy at Ho Chi Minh City (Approval No. 650/HDDD-DHYD dated July 6, 2023). All patients and their legal guardians were informed about the study procedures, benefits, and risks, and written consent was obtained. Patient confidentiality was strictly maintained.

Results

Among the 15 treated teeth, 10 (66.7%) were from male patients and 5 (33.3%) from female patients. The patients' age ranged from 7 to 14, with a median age of 10.0 years and interquartile range (IQR) of 9.3–11.7. Of the 15 teeth treated, 5 (33.3%) were upper central incisors, and 10 (66.7%) were lower second premolars. The etiologies of the periapical lesions were reported include both dental abnormalities and trauma. The dental abnormalities (dens evaginatus) was found in 10 cases (66.7%),

all of which occurred in premolars. Traumatic injury was identified as the cause in the remaining 5 cases of incisors (33.3%).

Initial clinical symptoms

At the initial evaluation, clinical symptoms were assessed for all 15 treated teeth. The most frequently observed finding was pain, followed by swelling and the presence of sinus tracts. Spontaneous pain was reported in 9 teeth (60.0%), while sensitivity to percussion was noted in 11 teeth (73.3%). Swelling was observed in 8 teeth (53.3%), and fistulae were present in 8 teeth (53.3%). These findings highlight the severity and symptomatic nature of the periapical pathology prior to intervention.

At the initial evaluation, all teeth had apical lesions with the mean area of the apical lesion before treatment was $37.6 \pm 35.2 \text{ mm}^2$ (range 4.8 to 118.2 mm^2). The mean horizontal size was $6.1 \pm 2.8 \text{ mm}$ (range 2.2 to 12.6 mm) and the mean vertical size was $7.9 \pm 4.0 \text{ mm}$ (range 2.1 to 15.5 mm).

Post-operative clinical symptoms

At day 1 after the obturation, there were 8 patients (57.1%) reported no pain and 6 patients (42.9%) had mild pain. However all they did not require medication and the pain subsided in following days.

At the re-examination one week after the obturation, all patients (100%) reported no spontaneous pain. There were 6 teeth had mild pain on percussion, these teeth belong to patients who also had mild pain after obturation. Additionally, the patients had no other symptoms.

Follow-up clinical and radiographic outcomes

The clinical outcome of endodontic treatment using bioceramic sealer and PRF apical barrier was positive. At the 1-month follow-up, all 15 teeth demonstrated complete resolution of clinical symptoms. No cases exhibited spontaneous pain, percussion sensitivity, swelling, or sinus tracts. No recurrent clinical symptoms were observed throughout the 12-month follow-up period. The patients reported no pain or tooth sensitivity and were satisfied with the treatment. The follow-up call regarding symptoms and function of teeth were made at the time of 12 months after treatment. All 14 patients reported that treated teeth were asymptomatic and functioning well.

About the radiographic outcome, the size of periapical lesions decreased over time. The size of the periapical lesions, including their area, horizontal and vertical dimensions are presented in Table 1. Comparing the size of periapical lesions, both area and size horizontally and vertically were significantly different between two consecutive time points.

Of the 15 initial periapical lesions on 15 teeth, after one month, one tooth no longer had a lesion. After that, the lesion healing occurred rapidly, there were 10 teeth healed completely with no remaining

periapical lesions observed on radiograph at the two months follow-up visit. The number of healed teeth at the three and six months follow-up visits were 13 and 15 respectively. At 6-month follow-up, the root hard tissue formation was observed radiographically at the apex in 9 teeth, corresponding to 60.0% of treated teeth. Figure 2 showed the radiographs of an mandibular premolar at the baseline and 6 months after treatment.

Table 1
The area and two- dimension sizes of the periapical lesions

Baseline	Area of lesion (mm²) (min-max)	Horizontal size (mm) (min-max)	Vertical size (mm) (min-max)
	37.6 ± 35.2 (4.8–118.2)	6.1 ± 2.8 (2.2–12.6)	7.9 ± 4.0 (2.1–15.5)
1 month	17.0 ± 3.0 0–66.3	4.4 ± 3.0 (0-10.9)	4.6 ± 2.4 (0-8.6)
2 months	4.4 ± 9.0 0-31.4	1.2 ± 2.1 (0-6.9)	1.8 ± 2.7 (0-6.8)
3 months	1.0 ± 3.1 0–11.8	0.5 ± 1.4 (0–5.0)	0.4 ± 1.0 (0-3.5)

At 6-month follow-up, no periapical lesion was observed on the radiographs and the formation of a mineralized apical barrier was observed at 9 teeth (60.0%). There was no significant different of root apex development between males and females ($p > 0.05$).

Discussion

In this case series of 15 immature permanent teeth, placing a PRF apical matrix followed by warm obturation with bioceramic sealer led to complete clinical resolution in 15/15 (100%) by 1 month. The patients reported no pain or tooth sensitivity and were satisfied with the treatment. The good outcome of this case series was similar with several studies using a combination of MTA and PRF [7, 9, 12]. The sealer was used in this case series is Bio-C® Sealer, a premixed calcium silicate-based bioceramic material [12]. In these teeth, the open apices, short root length, and thin dentinal walls affected to the endodontic treatment's prognosis. So the bioceramic sealer was choiced due to the biocompatibility. Calcium silicate based sealer was reported to prevent apical fluid and seal tightlier than traditional sealers in case of open root apex [10].

Although, the apical barrier is still neccessary to prevent overextension of obturating material. There are some material can be used for this purpose, such as MTA, MTA incorporated with fiber mesh, PRF [7, 9, 12]. PRF have been known is effective in pain reduction and wound healing after dental procedures and

oral surgeries [11]. In this study, PRF was used for both purposes: as an apical barrier and to relieve pain and promote healing of periapical lesions. Mechanistically, PRF offers multiple advantages: (1) its fibrin scaffold provides mechanical support for the sealer; (2) it serves as a matrix for cell migration and neovascularization; (3) it facilitates controlled release of growth factors such as PDGF, TGF, and IGF-1, which stimulate collagen production, increase blood circulation and (4) it contains leukocytes that actively regulate the healing and immune response [7, 10, 11, 12].

The clinical symptoms in days after the operation were mild, no patient needs medication to reduce pain. In this study, PRF was placed through the root canal to the apical lesion without surgery. Because patients do not undergo surgery, this treatment strategy minimizes both physical and psychological impact so it is appropriate with the young age of patients.

The periapical lesions often heal quite slowly after non-surgical endodontic treatment regardless of sealer type. Bioceramic sealer reported better healing, but healing only was evident after years [11]. But in this study, the healing process had been relatively fast, all teeth showed any periapical lesions was observed in the radiographs after six months. This showed that the combination of bioceramic sealer and PRF should be indicated in case of immature permanent teeth with periapical lesions. This approach may improve the long-term prognosis of immature permanent teeth with necrotic pulps and periapical pathology.

The clinical outcome were successful and completed healing was observed radiographically after 6 months, however longer-term follow-up is necessary to assess the durability and stability of the healing.

Limitations of the study

This study has several limitations that should be acknowledged. First, the sample size is relatively small, and only single-rooted teeth were included, which limits the generalizability of the findings. Second, periapical lesions were monitored using periapical radiographs, which has the disadvantage of only assessing the healing in two dimension. Cone-beam computed tomography (CBCT) would allow three-dimensional assessment of periapical tissue repair. Third, the study design was a clinical case series with non-randomized sampling and no control group, which reduces the strength of the evidence. Finally, although root hard tissue formation at the apex was observed radiographically during follow-up, the absence of initial criteria prevented adequate assessment and reporting of root development after treatment.

Future research should address these limitations by employing randomized controlled clinical study designs with appropriately calculated sample sizes to ensure representativeness. The use of three-dimensional imaging techniques such as CBCT is recommended for more accurate assessment of bone healing and root formation.

Conclusion

The combined use of MTA Bio-C® Sealer and platelet-rich fibrin (PRF) as an apical barrier demonstrated favorable clinical and radiographic outcomes in the treatment of immature permanent teeth with periapical lesions. All treated cases showed resolution of clinical symptoms and progressive radiographic healing, with complete lesion resolution observed within six months.

Declarations

ACKNOWLEDGMENT

The authors thank the patients and their families for their trust and cooperation throughout the study period.

Funding: This research received no external funding.

Conflicts of interest: The authors declare that they have no competing interests.

Ethics approval and consent to participate: Ethical approval was required for this study. Approval No. 650/HDDD-DHYD dated July 6, 2023 by the Ethics Committee for Biomedical Research of the University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam. Informed consent was obtained from all participants.

The methods were performed in accordance with the principles of the Declaration of Helsinki and the National guidelines on ethics in biomedical research from Vietnam Ministry of Health.

Consent for publication: Written informed consent for publication of their clinical details and/or clinical images was obtained from the patients and their parent/legal guardian of the patients.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

References

1. Cvek M. Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta-percha. A retrospective clinical study. *Endod Dent Traumatol.* 1992;8(2):45–55. 10.1111/j.1600-9657.1992.tb00228.x. PMID: 1521505.
2. Peters OA, Laib A, Rügsegger P, Barbakow F. Three-dimensional analysis of root canal geometry by high-resolution computed tomography. *J Dent Res.* 2000;79(6):1405-9. 10.1177/00220345000790060901. PMID: 10890720.
3. Weiger R, Rosendahl R, Löst C. Influence of calcium hydroxide intracanal dressings on the prognosis of teeth with endodontically induced periapical lesions. *Int Endod J.* 2000;33(3):219–26.
4. Siqueira JF Jr. Endodontic infections: concepts, paradigms, and perspectives. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2002;94(3):281 – 93. 10.1067/moe.2002.126163. PMID: 12324780.

5. Zhang W, Li Z, Peng B. Assessment of a new root canal sealer's apical sealing ability. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2009;107(6):e79-82. 10.1016/j.tripleo.2009.02.024. PMID: 19464650.
6. Al-Haddad A, Che Ab Aziz ZA. Bioceramic-Based Root Canal Sealers: A Review. *Int J Biomater.* 2016;2016:9753210. 10.1155/2016/9753210. . Epub 2016 May 3. PMID: 27242904; PMCID: PMC4868912.
7. Choukroun J, Adda F, Schoeffler CVA, Schoeffler C, Vervelle A. An opportunity in perio-implantology: the PRF. *Implantodontie*, vol. 42, pp. 55–62, 2001.
8. Miron RJ, Fujioka-Kobayashi M, Bishara M, Zhang Y, Hernandez M, Choukroun J. Platelet-Rich Fibrin and Soft Tissue Wound Healing: A Systematic Review. *Tissue Eng Part B Rev.* 2017;23(1):83–99. 10.1089/ten.TEB.2016.0233. . Epub 2016 Oct 10. PMID: 27672729.
9. Pham VK, Pham TL, Pham AT, Le HL, Tran TB, Hoang MC, Vo TB, Vy KN, Tran MH, Tran TA, Bui MA, Hoang AD, Nguyen NP, Nguyen TT, Nguyen PN, Tran TT, Nguyen CH. Platelet rich fibrin and MTA in the treatment of teeth with open apices. *BMC Oral Health.* 2024;24(1):230. 10.1186/s12903-024-03923-5. Erratum in *BMC Oral Health.* 2024;24(1):318. doi: 10.1186/s12903-024-04087-y. PMID: 38350906; PMCID: PMC10865586.
10. Zordan-Bronzel CL, Torres FFE, Tanomaru-Filho M, Chávez-Andrade GM, Bosso-Martelo R, Guerreiro-Tanomaru JM. Evaluation of Physicochemical Properties of a New Calcium Silicate–based Sealer, Bio-C Sealer. *J Endod.* 2019;45(10):1248–52.
11. Khandelwal A, Janani K, Teja K, Jose J, Battineni G, Riccitiello F, Valletta A, Palanivelu A, Spagnuolo G. Periapical Healing following Root Canal Treatment Using Different Endodontic Sealers: A Systematic Review. *Biomed Res Int.* 2022;2022:3569281. 10.1155/2022/3569281. . PMID: 35845966; PMCID: PMC9286882.
12. Lee LW, Hsiao SH, Lin YH, Chen PY, Lee YL, Hung WC. Outcomes of necrotic immature open-apex central incisors treated by MTA apexification using poly(ϵ -caprolactone) fiber mesh as an apical barrier. *J Formos Med Assoc*, vol. 118, no. 1, Pt 2, pp. 362–370, Jan 2019.

Figures

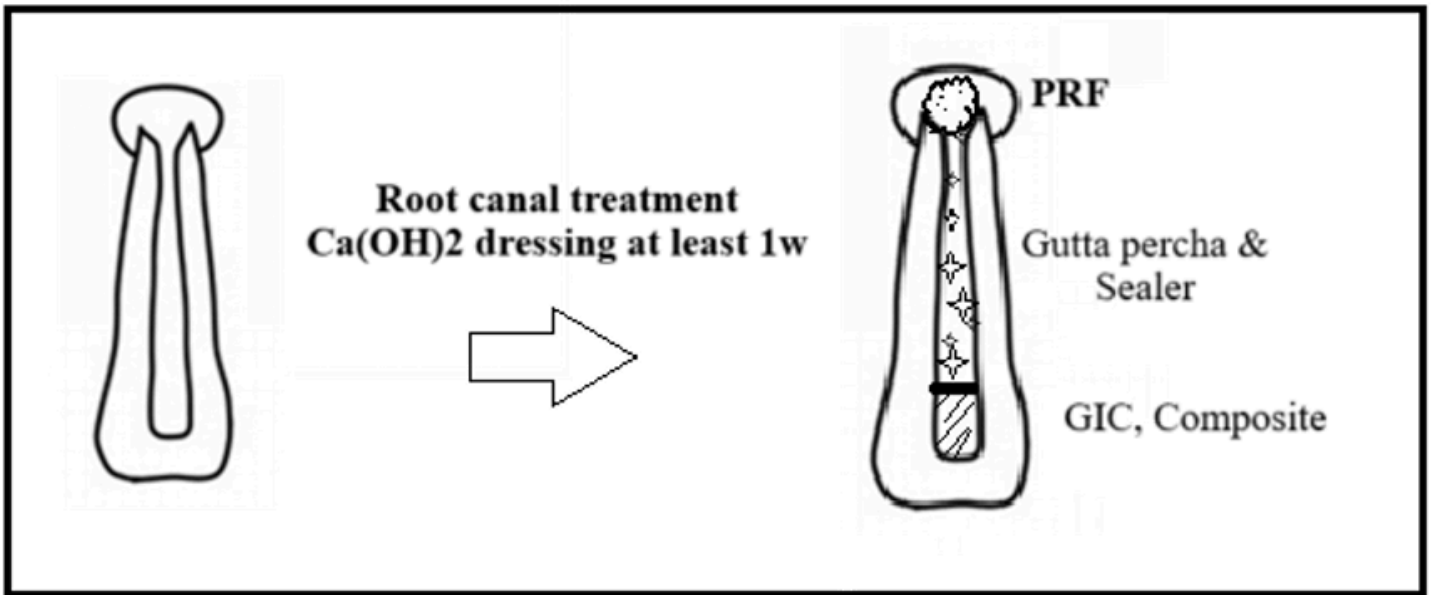


Figure 1

Illustration of the endodontic treatment process

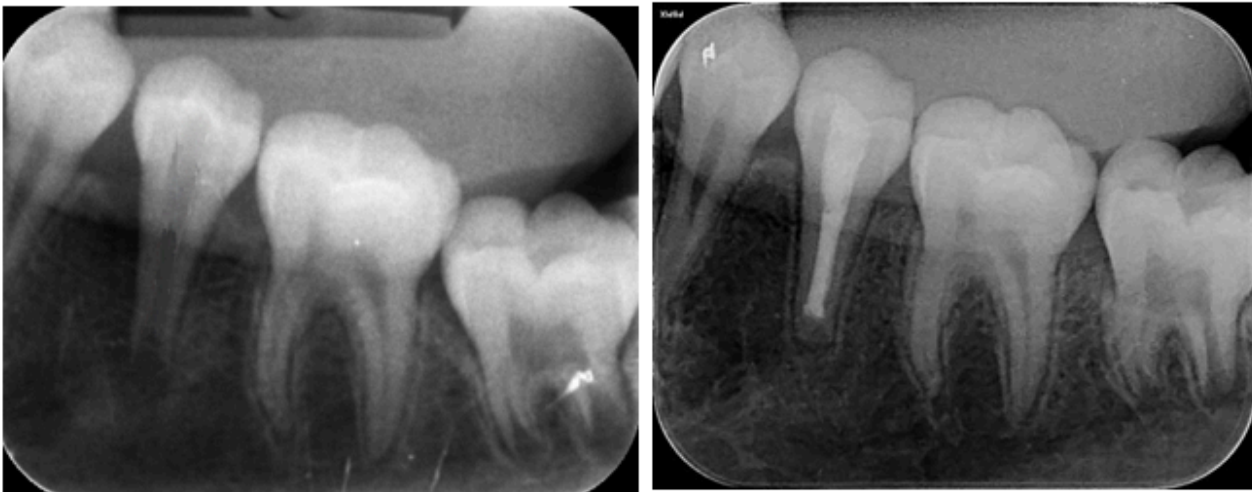


Figure 2

Periapical radiographs before and 6 months after the operation of a premolar. (before-left, 6 months after-right)