



Direct Clinical Evidence of Long-term Hard-tissue Repair after Miniature/Tampon Pulpotomy: An Accidental Re-entry Case after Six Years

Saeed Asgary^a , Leyla Roghanizadeh^{b*} , Mohammad Jafar Eghbal^a

^a Iranian Center for Endodontic Research, Research Institute for Dental Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran, ^b Dental Research Center, Research Institute for Dental Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Article Type: Case Report

Received: 17 Jun 2026

Accepted: 08 Jul 2026

Published: 20 Jul 2026

Doi: 10.22037/iej.v21i1.52842

***Corresponding author:** Leyla Roghanizadeh, Dental Research Center, Research Institute for Dental Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

E-mail: leila_roghani@yahoo.com

Abstract

Vital pulp therapy (VPT) has become an established biologically-based treatment for preserving pulp vitality in mature permanent teeth with irreversible pulpitis. Although long-term clinical success has been widely reported, direct clinical evidence demonstrating the biological outcome beneath the pulp-capping material years after treatment is exceptionally rare because successfully treated teeth seldom require re-entry. A mature mandibular first molar diagnosed with symptomatic irreversible pulpitis associated with symptomatic apical periodontitis underwent a miniature pulpotomy. Because conventional hemostasis could not be achieved, the calcium-enriched mixture (CEM) cement tampon approach was used. Clinical and radiographic follow-up demonstrated resolution of symptoms, preservation of pulp sensibility, and progressive formation of a dentin bridge. Six years later, fracture of the coronal restoration necessitated restorative retreatment. Removal of the fractured restoration and residual CEM cement unexpectedly exposed the original pulpotomy site, revealing a continuous, mature mineralized dentin bridge that completely covered the pulp exposure. The tooth was conservatively restored, and one year later (seven years after the original treatment), it remained asymptomatic, responsive to pulp sensibility testing, and free of radiographic signs of periapical disease. This accidental re-entry provided a rare opportunity to directly visualize long-term hard-tissue repair following miniature pulpotomy with the CEM cement tampon approach. Together with sustained pulp vitality and complete periapical healing over seven years, this case provides uncommon clinical evidence supporting the long-term biological effectiveness of conservative VPT in mature permanent teeth.

Keywords: Apical Periodontitis; CEM Cement; Dentin Bridge; Irreversible Pulpitis; Mineral Trioxide Aggregate; Pulpotomy; Vital Pulp Therapy

Introduction

Vital pulp therapy (VPT) has emerged as a biologically-based treatment strategy for preserving the vitality and function of inflamed pulps in permanent teeth [1]. Growing clinical evidence has challenged the traditional concept that teeth diagnosed with irreversible pulpitis invariably require root canal treatment [2, 3]. Instead, contemporary studies have demonstrated that conservative pulp-preserving procedures, when combined with bioactive calcium silicate cements and an adequate coronal seal,

can achieve predictable long-term clinical and radiographic success even in mature permanent teeth with advanced pulpal inflammation [4]. Consequently, VPT is increasingly regarded as a minimally invasive treatment that preserves the tooth's natural defense, sensory, and reparative functions.

Clinical success following VPT is generally determined by the absence of symptoms, positive pulp sensibility responses, and radiographic evidence of continued periapical health. Although these surrogate clinical outcomes strongly suggest successful healing, they provide only indirect evidence of the biological events

occurring beneath the pulp-capping material. Histological studies have demonstrated dentin bridge formation and maintenance of pulp vitality after treatment; however, such observations are largely limited to animal experiments or extracted human teeth [5-7]. In routine clinical practice, successfully treated teeth rarely undergo late re-entry, making direct evaluation of the healed pulp exposure site exceptionally uncommon.

One of the principal determinants of successful VPT is the effective control of pulpal hemorrhage before the placement of the capping biomaterial. Persistent bleeding has traditionally been interpreted as a marker of extensive pulpal inflammation and has often been considered an indication for more invasive treatment [8]. To address situations in which conventional hemostasis cannot be achieved, the calcium-enriched mixture (CEM) cement tampon approach was proposed as a biological strategy in which the calcium silicate cement simultaneously acts as a hemostatic tampon and a bioactive pulp-capping material [9]. Although favorable clinical outcomes using this technique have been reported [10-12], opportunities to directly verify the long-term biological response of the pulp following this approach have remained extremely limited [13].

The present report describes a unique accidental re-entry six years after a miniature pulpotomy performed using the CEM cement tampon approach. Fracture of the coronal restoration unexpectedly exposed the original treatment site, allowing direct clinical visualization of a mature mineralized dentin bridge in a fully functional tooth. To our knowledge, such long-term direct clinical confirmation of hard-tissue repair following miniature pulpotomy is exceptionally rare. This case, therefore, provides unusual clinical evidence supporting the long-term biological effectiveness of conservative vital pulp therapy in a mature permanent tooth.

Case Report

A 34-year-old female patient was referred for the treatment of a symptomatic mandibular molar with a non-contributory medical history. Her mature mandibular first molar presented with spontaneous pain and tenderness to percussion. The tooth had lingering pain upon cold testing (Endo-frost Cold Spray; Roeko; Coltene Whaledent, Langenau, Germany), and a normal probing depth (≤ 3 mm). Radiographic evaluation demonstrated extremely deep caries extending to the pulp horn and PDL widening. Clinical and radiographic examinations established the diagnosis of symptomatic irreversible pulpitis associated with symptomatic apical periodontitis (Fig. 1A). After obtaining informed consent, a miniature pulpotomy was selected as the definitive treatment.

After a 0.12% chlorhexidine mouth rinse and administration of local anesthesia with 2% lidocaine plus 1:80000 epinephrine (DaruPakhsh, Tehran, Iran), the dental pulp was exposed following complete removal of the caries. Following removal of the inflamed superficial pulp tissue with a round-end sterile diamond bur to perform a miniature pulpotomy, a sterile cotton pellet soaked in 2.5% sodium hypochlorite solution was gently placed over the pulp for ~2 min; however, persistent pulpal hemorrhage prevented conventional hemostasis. Therefore, the CEM cement (Bionique Dent, Tehran, Iran) tampon approach [9] was employed to simultaneously control bleeding and seal the pulp wound. The tooth was permanently restored with resin composite material (Z250; 3M/ESPE, St Paul, MN, USA) during the same appointment (Fig. 1B).

The postoperative course was uneventful. The patient reported complete relief of symptoms within 24 h. Periodic follow-up examinations demonstrated normal clinical findings, positive pulp sensibility responses, absence of tenderness to percussion or palpation, and progressive dentin bridge formation beneath the capping material (Fig. 1C), indicating successful maintenance of pulp vitality.

Six years later, the patient returned after fracturing the tooth and coronal restoration while biting on a hard object. Clinical examination revealed coronal structural loss without signs of pulpal or periapical disease. Radiographic examination demonstrated normal periodontal ligament space, intact lamina dura, and no evidence of periapical pathology (Fig. 1D, E).

During restorative retreatment, removal of the fractured restoration along with the residual CEM cement, unexpectedly exposed the previous pulpotomy site. A continuous, well-organized mineralized dentin bridge was directly visible to the naked eye (Fig. 1F). The bridge appeared intact, completely covered the original exposure site, and exhibited a smooth, mature surface. This accidental re-entry provided a unique opportunity to directly verify the biological outcome of the original VPT procedure.

After conservative cavity preparation, the tooth was restored with amalgam (Cinalux; Shahid Faghihi, Tehran, Iran) (Fig. 1G). The immediate postoperative radiograph clearly demonstrated the radiographic outline of the mineralized bridge beneath the packed amalgam restoration (Fig. 1H).

At the one-year review following retreatment (seven years after the original miniature pulpotomy), the tooth remained asymptomatic and fully functional. Pulp sensibility responses were positive and comparable with those of adjacent and contralateral control teeth. Radiographic examination confirmed maintenance of pulp vitality, complete periapical healing, and structural stability of the dentin bridge (Fig. 1I).

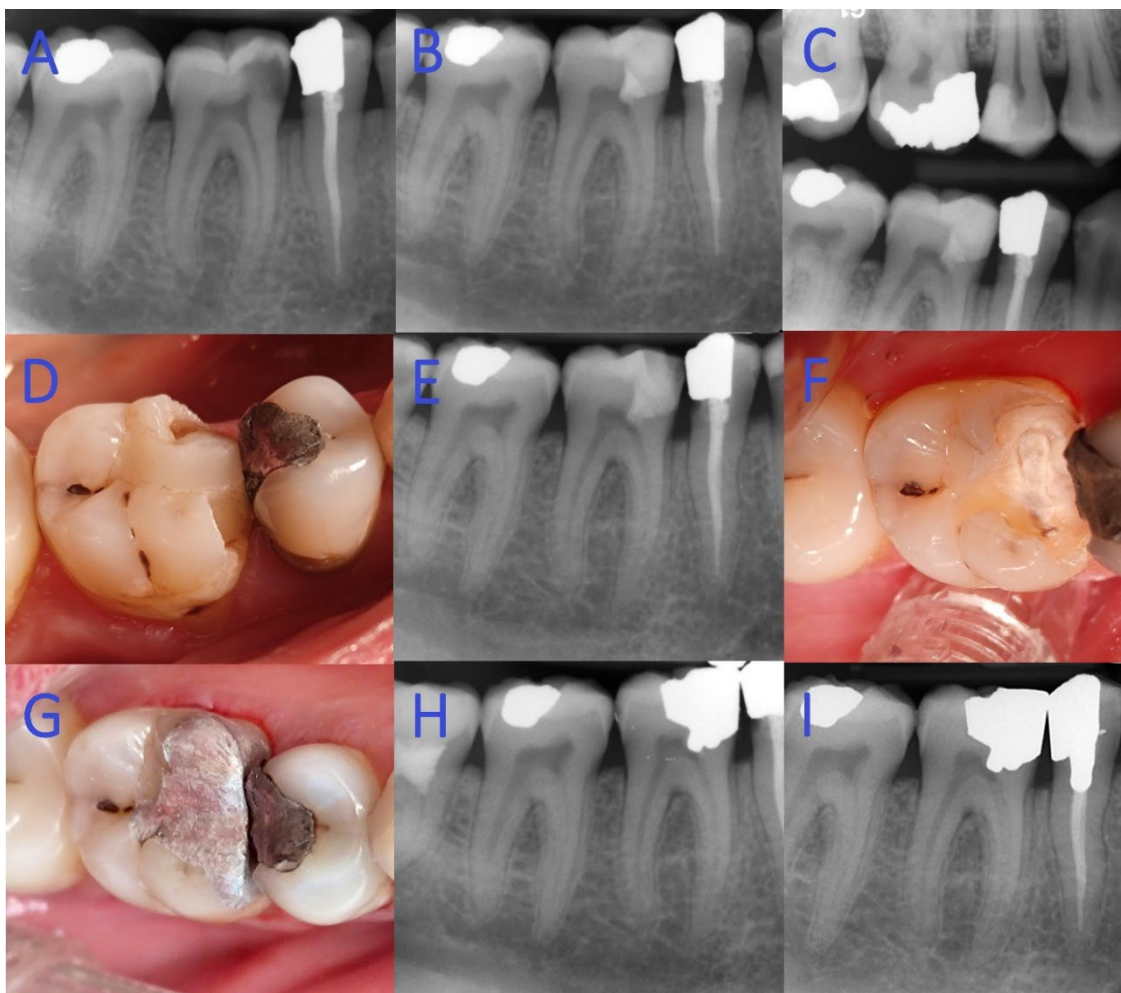


Figure 1. Long-term follow-up of miniature/tampon pulpotomy with CEM cement in a mandibular first molar with irreversible pulpitis and symptomatic apical periodontitis; A) Preoperative radiograph: extremely deep caries with PDL widening; B) Immediate post-op: CEM cement tampon pulpotomy and composite restoration; C) Two-year follow-up: a thin dentin bridge formed; D, E) Six-year follow-up: fracture of tooth and restoration, with normal PDL and intact dentin bridge; F) Clinical re-entry: the mature dentin bridge is directly visible after removing the restoration and cement; G, H) Conservative retreatment and amalgam restoration, with bridge outline visible radiographically; I) Seven-year follow-up: stable periapical health and maintained pulp sensibility

Discussion

Successful VPT is generally assessed using clinical findings, pulp sensibility testing, and radiographic examination. Direct observation of the healed pulp exposure site is rarely possible because successful teeth usually remain functional and do not require retreatment. Consequently, clinical evidence confirming the actual morphology of the repaired tissue in long-term human cases is scarce [14]. In the present case, accidental re-entry six years after treatment provided a rare opportunity to directly visualize a mature mineralized dentin bridge in a functioning tooth. This observation was consistent with the favorable clinical and radiographic findings recorded throughout the follow-up period, including maintenance of pulp sensibility and complete periapical healing.

The introduction of mineral trioxide aggregate (MTA) represented a major milestone in modern endodontics, fundamentally changing the management of VPT and other biologically based procedures. Originally developed from refined Portland cement with the addition of radiopacifying agents [15], MTA demonstrated unprecedented biocompatibility, bioactivity, and the ability to stimulate hard-tissue formation, thereby establishing the calcium silicate cement (CSC) family as the gold standard for pulp preservation. Subsequently, other CSCs, including CEM cement, were developed to optimize handling characteristics and physicochemical properties while maintaining the favorable biological performance of the material class. Although MTA and CEM differ in their chemical composition and physical characteristics, both have consistently demonstrated

excellent biocompatibility, bioactivity, sealing ability, and favorable long-term clinical outcomes in VPT [16-25]. Despite the substantial experimental and clinical evidence supporting CSCs [26], opportunities to directly observe the mature hard tissue formed beneath these biomaterials in functioning human teeth years after treatment remain exceptionally rare. The present case, therefore, provides uncommon clinical evidence that the regenerative potential attributed to CSCs can translate into durable dentin bridge formation and long-term preservation of pulp vitality under clinical conditions.

The present report also supports the biological rationale of miniature pulpotomy using the CEM cement tampon approach. Despite initial uncontrolled pulpal bleeding (traditionally regarded as an unfavorable prognostic sign [27]), the pulp remained vital and functional for seven years after treatment. These findings are consistent with growing evidence suggesting that preservation of healthy residual pulp tissue, together with effective sealing by bioactive calcium silicate cements, may facilitate long-term tissue repair even in teeth diagnosed with irreversible pulpitis [28].

Furthermore, the successful clinical performance of the amalgam placed directly over the exposed bridge (without any intervening pulp protective layer) corroborates its structural completeness and confirms the absence of clinically relevant tunnel defects. This interpretation is supported by a comparative histologic study, in which CEM/MTA induced complete, inflammation-free dentinal bridge formation, significantly outperforming calcium hydroxide [29]. Conversely, a separate animal study found that the addition of calcium chloride to MTA did not enhance its histological performance as a pulp-capping agent [30]. Thus, the present clinical observation aligns with those findings, confirming that CSCs can generate a biologically robust and functionally integral hard-tissue barrier over the long term [31, 32].

Because this is a single case report, its findings should be interpreted cautiously and cannot be generalized. Nevertheless, the combination of long-term clinical success, maintained pulp sensibility, complete radiographic healing, and direct visualization of a mature dentin bridge provides unusually compelling clinical evidence supporting durable hard-tissue repair following biologically based VPT.

Conclusion

This accidental re-entry offered a rare opportunity to directly observe a mature dentin bridge six years after miniature pulpotomy using the CEM cement tampon approach. Together with sustained pulp vitality, complete periapical healing, and

seven years of successful clinical function, the findings provide unique clinical evidence supporting the long-term biological effectiveness of conservative VPT.

Acknowledgements

None.

Conflict of interest

None.

Funding support

None.

Author's contributions

Conceptualization: SA/MJE; Methodology: SA/MJE/LR; Investigation: SA/LR; Writing-Original Draft Preparation: SA/LR; Writing-Review and Editing: SA/LR/MJE; Supervision: SA. All authors read and approved the final manuscript.

References

1. Asgary S, Nosrat A. Vital Pulp Therapy: Evidence-Based Techniques and Outcomes. *Iran Endod J.* 2025;20(1):e2.
2. Asgary S, Eghbal MJ, Shahravan A, Saberi E, Baghban AA, Parhizkar A. Outcomes of root canal therapy or full pulpotomy using two endodontic biomaterials in mature permanent teeth: a randomized controlled trial. *Clin Oral Investig.* 2022;26(3):3287-97.
3. Farhadi A, Safarzadeh A, Nekouei AH, Sabeti M, Manoochehrifar H, Shahravan A. Comparative Outcomes of Pulpotomy in Mature Molars with Irreversible Pulpitis: A Non-Randomized Trial Evaluating Calcified and Non-Calcified Pulp Chambers. *Iran Endod J.* 2024;19(1):13-21.
4. Asgary S, Roghanizadeh L, Eghbal MJ, Akbarzadeh Baghban A, Aminoshariae A, Nosrat A. Outcomes and predictive factors of vital pulp therapy in a large-scale retrospective cohort study over 10 years. *Sci Rep.* 2024;14(1):2063.
5. Tabarsi B, Parirokh M, Eghbal MJ, Haghdoust AA, Torabzadeh H, Asgary S. A comparative study of dental pulp response to several pulpotomy agents. *Int Endod J.* 2010;43(7):565-71.
6. Nassri S, Mardini A, Aljabban O, Alsayed Tolibah Y. Histological evaluation of vital full pulpotomy techniques in permanent mature teeth with symptomatic irreversible pulpitis using three calcium silicate cements: a randomized controlled trial. *BMC Oral Health.* 2025;26(1):37.
7. Sanusi SY, Al-Batayneh OB. Pulp Therapy of Primary Dentition; its Relevance despite Insufficient Histological Evidence: A Review. *Iran Endod J.* 2023;18(1):15-40.
8. Colloc TNE, Tomson PL. Vital pulp therapies in permanent teeth: what, when, where, who, why and how? *Br Dent J.* 2025;238(7):458-68.
9. Ardavan A, Roghanizadeh L, Asgary S. Tampon Vital Pulp Therapy in the Management of Excessive Haemorrhage in Inflamed Pulp: A Hypothesis. *Iran Endod J.* 2023;18(4):274-6.

10. Asgary S, Roghanizadeh L. Tampon Pulpotomy: Long-term Successful Results of a Molar with Irreversible Pulpitis and Previous Vital Pulp Therapy Failure. *Iran Endod J.* 2023;18(3):165-7.
11. Asgary S. Intraoperative Identification of Vital Radicular Pulp in a Tooth Diagnosed with Pulp Necrosis: Four-Year Outcome of Tampon Pulpotomy. *Iran Endod J.* 2026;21(1):e22.
12. Asgary S, Sarraf Shirazi A, Sabbagh S. Management of primary molars with irreversible pulpitis employing tampon pulpotomy: Report of three cases with 34-month mean follow-up. *Clin Case Rep.* 2021;9(4):2289-94.
13. Kahler B, Taha NA, Lu J, Saoud TM. Vital pulp therapy for permanent teeth with diagnosis of irreversible pulpitis: biological basis and outcome. *Aust Dent J.* 2023;68 Suppl 1:S110-s22.
14. Taha NA, About I, Sedgley CM, Messer HH. Conservative Management of Mature Permanent Teeth with Carious Pulp Exposure. *J Endod.* 2020;46(9s):S33-s41.
15. Asgary S, Parirokh M, Eghbal MJ, Brink F. A comparative study of white mineral trioxide aggregate and white Portland cements using X-ray microanalysis. *Aust Endod J.* 2004;30(3):89-92.
16. Naghavi N, Ghoddusi J, Sadeghnia HR, Asadpour E, Asgary S. Genotoxicity and cytotoxicity of mineral trioxide aggregate and calcium enriched mixture cements on L929 mouse fibroblast cells. *Dent Mater J.* 2014;33(1):64-9.
17. Asgary S, Parirokh M, Eghbal MJ, Ghoddusi J, Eskandarizadeh A. SEM evaluation of neodentinal bridging after direct pulp protection with mineral trioxide aggregate. *Aust Endod J.* 2006;32(1):26-30.
18. Yavari HR, Samiei M, Shahi S, Aghazadeh M, Jafari F, Abdollahi M, et al. Microleakage comparison of four dental materials as intra-orifice barriers in endodontically treated teeth. *Iran Endod J.* 2012;7(1):25-30.
19. Nosrat A, Asgary S. Apexogenesis of a symptomatic molar with calcium enriched mixture. *Int Endod J.* 2010;43(10):940-4.
20. Fallahinejad Ghajari M, Asgharian Jeddi T, Iri S, Asgary S. Treatment outcomes of primary molars direct pulp capping after 20 months: a randomized controlled trial. *Iran Endod J.* 2013;8(4):149-52.
21. Nosrat A, Asgary S, Eghbal MJ, Ghoddusi J, Bayat-Movahed S. Calcium-enriched mixture cement as artificial apical barrier: A case series. *J Conserv Dent.* 2011;14(4):427-31.
22. Roghanizadeh L, Torabzadeh H, Parhizkar A, Akbarzadeh Baghban A, Asgary S. Effect of Manipulation Methods and Storage Environments on the Microstructural, Chemical, and Mechanical Properties of Calcium-Enriched Mixture Cement. *Int J Biomater.* 2025;2025:5560351.
23. Shabani Panbeh Choleh S, Heidari M, Kazeminejad E, Mohammadi M, Rajabi A. Cytocompatibility of Three Calcium Silicate-Based Biomaterials: A Systematic Review and Meta-Analysis. *Iran Endod J.* 2026;21(1):e12.
24. Asgary S, Fazlyab M, Sabbagh S, Eghbal MJ. Outcomes of different vital pulp therapy techniques on symptomatic permanent teeth: a case series. *Iran Endod J.* 2014;9(4):295-300.
25. Panahandeh N, Torshabi M, Askian R, Torabzadeh H, Asgary S. Cytotoxicity of Calcium Silicate-Based Cements: Role of Bonding Time, Strategy, and Thickness in an In Vitro Model. *Iran Endod J.* 2025;20(1):e20.
26. Tran XV, Salehi H, Truong MT, Sandra M, Sadoine J, Jacquot B, et al. Reparative Mineralized Tissue Characterization after Direct Pulp Capping with Calcium-Silicate-Based Cements. *Materials (Basel).* 2019;12(13).
27. Coll JA, Dhar V, Guelmann M, Crystal YO, Chen CY, Marghalani AA, et al. Vital Pulp Therapy in Permanent Teeth: A Systematic Review and Meta-Analyses. *Pediatr Dent.* 2025;47(3):137-50.
28. Dhar V, El-Karim I, Coll JA, Fouad AF, O'Connell AC, Asgary S, et al. Consensus-Based Recommendations on Pulp Therapies in Primary and Permanent Teeth: IAPD Porto Forum. *Int J Paediatr Dent.* 2026;36(2):371-86.
29. Asgary S, Eghbal MJ, Parirokh M, Ghanavati F, Rahimi H. A comparative study of histologic response to different pulp capping materials and a novel endodontic cement. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics.* 2008;106(4):609-14.
30. Parirokh M, Asgary S, Eghbal MJ, Kakoei S, Samiee M. A comparative study of using a combination of calcium chloride and mineral trioxide aggregate as the pulp-capping agent on dogs' teeth. *J Endod.* 2011;37(6):786-8.
31. Tsujigami Y, Watanabe C, Zhong J, Ikeda M, Han R, Zhou J, et al. Mechanistic insights into dentin bridge properties in a vital pulp therapy mimetic murine model. *J Mech Behav Biomed Mater.* 2026;178:107416.
32. Cabrera-Fernández A, Dominguez-Dominguez L, Pérez-Pérez A, Santos JMM, Díaz-Cuenca A, Torres-Lagares D, et al. Clinical and Radiographic Outcomes of Vital Pulp Therapy Using Resin-Modified Versus Conventional Calcium Silicate-Based Materials: A Systematic Review and Meta-Analysis. *J Funct Biomater.* 2026;17(1).

Please cite this paper as: Asgary S, Roghanizadeh L, Eghbal MJ. Direct Clinical Evidence of Long-term Hard-tissue Repair after Miniature/Tampon Pulpotomy: An Accidental Re-entry Case after Six Years. *Iran Endod J.* 2026;21(1): e24. Doi: 10.22037/iej.v21i1.52842.