JOURNAL of ENDODONTICS and RESTORATIVE DENTISTRY

E-ISSN: 2980-3748

Case Series

Clinical Applications of the Newly Generated MAP VPT System in Different Vital Pulp Therapies: A Case Series

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ARTICLE INFO

Received: 23.11.2025
Completion of First Review: 16.12.2025
Accepted: 04.01.2026
Published: 01.03.2026

KEYWORDS

Endodontics
Pulp capping
Pulpotomy
Vital pulp treatment

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CLINICAL SIGNIFICANCE

The MAP VPT system enables accurate and controlled delivery and placement of hydraulic cements, minimizes procedural errors, and enhances efficiency. Its design supports consistent outcomes across different vital pulp treatment, offering clinicians a practical, predictable, and user-friendly approach.

ABSTRACT

This report presents the clinical usability and practicability of the newly-generated MAP VPT system across different vital pulp treatments (VPTs). Three healthy patients with pulpal diagnoses of reversible pulpitis and irreversible pulpitis were treated with direct pulp capping, partial pulpotomy, and total pulpotomy. Following the achievement of hemostasis, mineral trioxide aggregate (MTA) was delivered via the MAP VPT. Patients were recalled at 1 week, 1, 3, 6, and 8 months. In all cases, the system enabled precise and homogeneous placement of the material, reducing procedural time and minimizing contamination risk. Clinical and radiographic follow-ups confirmed asymptomatic, functional teeth with preserved pulp vitality. The present case series highlights the practical advantages of the MAP VPT system in facilitating accurate, controlled, and contamination-free placement of MTA during different VPTs. Further clinical studies with larger sample sizes and long-term follow-up are recommended to comprehensively assess the system's impact on treatment success and material performance.

1. Introduction

Modern endodontic practice has progressively shifted toward the adoption of vital pulp treatments (VPTs), which are founded on biologically oriented and minimally invasive principles.[1] As outlined in the collaborative consensus report by the American Association of Endodontists (AAE) and the European Society of Endodontology (ESE) on diagnostic terminology, even in the case of severe pulpitis, VPTs can be applied.[2] Therefore, the implementation of a case-specific VPT using scientifically validated biomaterials and clinically appropriate techniques is of paramount importance to preserve pulp vitality and maintain long-term tooth function.

VPTs encompass various treatment modalities, including indirect pulp capping, direct pulp capping, and pulpotomy procedures, depending on the severity and stage of the pulpal pathology.[3] During these treatments, one of the key factors is the biocompatible material applied to the pulp tissue.[4] In this sense, the introduction of mineral trioxide aggregate (MTA) as a biocompatible material into the literature has notably enhanced treatment outcomes by overcoming the drawbacks associated with the use of calcium hydroxide (CH).[5] Although clinical studies have reported a high success rate of MTA in VPTs,[6, 7] some clinical properties related to the handling, setting, and discoloration have prompted the development of novel hydraulic cements (HCs) exhibiting diverse chemical compositions and biological characteristics.[5]

Another critical aspect of successful VPTs is the accurate delivery and placement of HC into the pulp chamber. Conventional material delivery during VPTs is commonly performed using spatulas and hand instruments. While these methods are readily available, they are often technique-sensitive and may be associated with inconsistent material transfer, limited control over placement, increased risk of contamination, and material loss—particularly in deep pulpotomy cavities and molar teeth. These limitations have prompted the development of dedicated carrier systems aimed at improving delivery accuracy and clinical efficiency.[8-10] Among these, the Micro-Apical Placement (MAP) system has become widely adopted due to its efficiency in delivering HCs into narrow or difficult-to-access areas. However, the conventional MAP system was originally designed for apical and confined operative fields and may be insufficient for VPTs, where wider coronal cavities and the placement of larger volumes of material are required. In such clinical scenarios, limitations related to tip diameter, material flow capacity, and delivery efficiency may compromise homogeneous placement and increase the risk of material loss or prolonged operative time. This represents a specific clinical gap in VPT procedures, where precise, contamination-free, and volumetrically adequate delivery of HCs onto exposed pulp tissue is critical for treatment success. To address this limitation, a modified version of the system—designated as the MAP VPT—has been introduced. This adaptation features a tip with an enlarged internal diameter, specifically engineered to facilitate the controlled placement of the greater HC volumes required for VPT applications. According to the manufacturer, the improved ergonomics and structural robustness of this system enable uniform material delivery with minimal waste, thereby enhancing procedural accuracy and clinical outcomes.[11]

Although the MAP VPT system was developed towards the end of 2024, its clinical effectiveness has not been demonstrated to date. In this context, the present case series aimed to present the clinical usability and practicability of the MAP VPT system across different VPTs (direct pulp capping, partial pulpotomy, total pulpotomy).

2. Case Presentation

This report of 3 cases was written to comply with the Consensus-based Clinical Case Reporting Guideline (CARE) (Supplementary Material Checklist). All patients were informed about VPTs, including their objectives, potential risks, benefits, and alternatives. Informed consents were obtained, ensuring that they fully understood and agreed to the proposed treatment plan. All procedures were completed in a single appointment by the same endodontist with seven years of experience in the field. For all cases, clinical success was determined by the absence of spontaneous pain, sensitivity to percussion or palpation, swelling, or sinus tract formation, together with a normal, non-lingering response to pulp sensibility testing. Radiographic success was defined as the absence of periapical radiolucency, internal or external root resorption, or other pathological changes (periapical index (PAI)) on periapical radiographs obtained at recall visits.

2.1. Case 1 (Direct pulp capping)

Fig. 1 shows the clinical steps. A 26-year-old healthy female patient presented to the Department of Endodontics with a chief complaint of thermal sensitivity in tooth 37. The patient reported that the discomfort was transient and subsided upon removal of the stimulus. The tooth responded positively to both cold and electric pulp testing (EPT), indicating a vital pulp response, and no sensitivity to percussion or palpation was observed. Periodontal probing depth was <3mm. Periapical radiographic evaluation demonstrated a large restoration with recurrent caries, without periapical radiolucency. Based on these findings, the tooth was diagnosed with reversible pulpitis.

After administration of local anesthesia (2% lidocaine with 1:100,000 epinephrine), rubber dam isolation was achieved, and the operative field was disinfected with 3% hydrogen peroxide

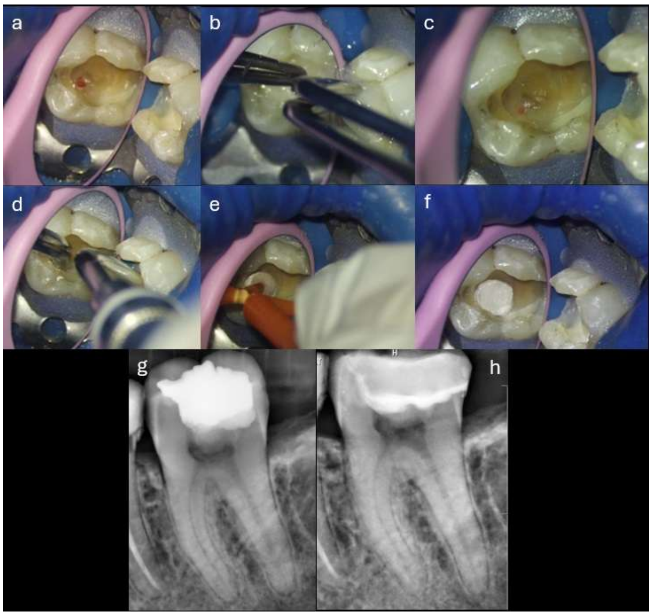

Fig. 1. (A) Pulp exposure, (B) Hemostasis, w/ 3% NaOCl, (C) Confirmation of hemostasis and clean surface, (D) Placement of MTA using MAP VPT, (E) Gently condensation, (F) Confirmation of adequate placement, (G) Preoperative radiograph, (H) 8-month follow-up radiography

Fig. 2. (A) Pulp exposure and bleeding, (B) Hemostasis, w/ 3% NaOCl, (C) Confirmation of hemostasis and clean surface, (D) Placement of MTA using MAP VPT, (E) Gently condensation, (F) Confirmation of adequate placement, (G) Preoperative radiograph, (H) 6-month follow-up radiography

(H_2O_2) for 30 seconds, followed by 2.5% sodium hypochlorite (NaOCl) for the same duration, and neutralized using 5% sodium thiosulfate. The existing restoration and carious dentin were carefully removed under a dental operating microscope (DOM, LABOMED; Labo America, Inc., Fremont, CA, US) using a sterile round carbide bur in a high-speed handpiece under continuous water cooling. During caries excavation, a pulp exposure was detected. Hemorrhage control was achieved within five minutes by gently applying 3% NaOCl with a sterile cotton pellet. Once hemostasis and a clean surface were confirmed, a thin layer of mineral trioxide aggregate (PD MTA, Produits Dentaires, Vevey, Switzerland) was carefully placed over the exposure site using the MAP VPT (Produits Dentaires, Vevey, Switzerland) system. The material was slightly condensed and covered with a moistened micro applicator for initial setting. Over the MTA, a glass liner (WP Dental, Germany) was placed as a base. Afterwards, Clearfil S3 Bond Universal was applied to the surface using a microbrush and actively rubbed for 10 s. A gentle air stream was then applied for 5 s to evaporate the solvent and form a uniform thin film. The adhesive was light-cured for 10 s using a Cordless LED 1 SEC Curing Light with an irradiance of 1500 mW/cm². Subsequently, the restoration was done with composite (G-aenial Posterior; GC Corporation, Tokyo, Japan), and polished. The patient was recalled at 1 week and at 1, 3, 6, and 8 months. At all follow-up visits, the tooth remained asymptomatic and functional, exhibiting normal responses to pulp sensibility testing and no sensitivity to percussion or palpation. Periapical radiographic evaluation demonstrated the absence of periradicular pathology, root resorption, or other pathological changes (PAI 1), thereby meeting the predefined clinical and radiographic success criteria for cases.

2.2. Case 2 (Partial pulpotomy)

Fig. 2 shows the clinical steps. A 14-year-old female patient without systemic disease was referred to the Department of Endodontics with a complaint of spontaneous and lingering pain in tooth 47. The patient reported sensitivity to thermal stimuli, which persisted after removal of the stimulus. Clinical examination

Fig. 3. (A) Pulp exposure and bleeding, (B) Hemostasis, w/ 3% NaOCl, (C) Confirmation of hemostasis and clean surface, (D) Placement of MTA using MAP VPT, (E) Gently condensation, (F) Confirmation of adequate placement, (G) Preoperative radiograph, (H) 6-month follow-up radiography

revealed a large distal carious lesion, and the tooth exhibited a prolonged positive response to cold and EPT, while percussion and palpation were negative. Periodontal probing depth was <3mm. Radiographic examination showed deep caries approaching the pulp chamber without any signs of periapical pathology. Based on these findings, the tooth was diagnosed with symptomatic irreversible pulpitis.

After obtaining informed consent, preoperative preparations were conducted as described in Case 1. During caries excavation, the distal pulp horn was exposed, accompanied by profuse bleeding. The exposed area and surrounding inflamed coronal pulp tissue in the distal pulp horn were carefully removed using a sterile sharp excavator. Hemostasis was achieved within five to six minutes by gently applying 3% NaOCl with a sterile cotton pellet. Once hemostasis and a clean surface were confirmed, freshly mixed PD MTA was carefully placed over the exposure site using the MAP VPT system, gently condensed, and covered with a moistened micro applicator for initial setting. The permanent restoration was performed as described previously. Follow-up examinations were conducted at 1 week and at 1, 3, and 6 months. Throughout the recall period, the treated tooth remained symptom-free, demonstrated a positive and normal response to pulp sensibility testing, and showed no tenderness to percussion or palpation. Radiographic assessment at each visit revealed normal periapical conditions, with no signs of pathological alterations (PAI 1), confirming the success of treatment.

2.3. Case 3 (Total pulpotomy)

Fig. 3 shows the clinical steps. A 42-year-old healthy female patient presented to the Department of Endodontics with a chief complaint of severe, lingering pain in tooth 47. The pain was exacerbated by exposure to hot and cold stimuli and persisted after the stimulus was removed. Clinical examination revealed an existing occlusal amalgam restoration with recurrent caries. The tooth responded positively to cold and EPT with a prolonged response, while percussion and palpation were negative. Radiographic evaluation demonstrated secondary caries without a periradicular pathology. Based on clinical and radiographic findings, a diagnosis of symptomatic irreversible pulpitis was established.

After obtaining informed consent, preoperative preparations were conducted as described in Case 1. During caries removal, the pulp chamber was unroofed, and thus, total pulpotomy was performed. Profuse bleeding was controlled by applying 3% NaOCl with a sterile cotton pellet for approximately 8–9 minutes. Once the bleeding had stopped, freshly mixed PD MTA was placed into the pulp chamber floor using the MAP VPT system, gently condensed, and covered with a moistened micro applicator for initial setting. Subsequently, the permanent restoration was performed as described previously. Follow-up evaluations were performed at 1 week and at 1, 3, and 6 months. During all recall visits, the treated tooth showed no clinical symptoms, maintained functional integrity, and exhibited physiologic responses to pulp sensibility testing. Radiographic examination demonstrated stable periapical conditions without evidence of pathological findings (PAI 1), highlighting the success of treatment.

3. Discussion

VPT, as a conservative treatment approach, allows for the preservation of vitality and function of the dental pulp. Especially, the high success rate of VPTs,[12, 13] combined with ease of application and cost-effectiveness, has led to their widespread adoption as an alternative to root canal treatments. During VPTs, the precise and contamination-free carrying and placement of HC is essential for achieving a hermetic seal and promoting pulp healing. Thus, this case series aimed to demonstrate the clinical usability and practicality of the newly generated MAP VPT system in performing different VPT modalities.

In all three cases, the MAP VPT system demonstrated practical advantages with direct clinical implications. The system enabled single-step delivery of HC directly from the mixing stage to the pulp exposure site, thereby eliminating intermediate transfer steps that are commonly required when using spatulas or micropluggers. This streamlined workflow reduced handling complexity, shortened procedural time, and minimized the risk of material loss or contamination. Additionally, the improved ergonomics and controlled extrusion facilitated consistent material adaptation, particularly in posterior teeth and wider coronal cavities, supporting more predictable and efficient execution of VPTs.

In direct pulp capping procedures, the primary goal is to maintain the health and vitality of the pulp tissue following a small mechanical or carious exposure.[14] Thus, adequately placing HCs directly over the exposed pulp surface is crucial for providing a tight seal and stimulating dentin bridge formation. However, the placement of this material can be technically challenging, especially in confined or deep operative fields. In this present case, MTA was directly placed over a small exposure using MAP VPT. The use of the MAP VPT system enabled precise delivery of the material, minimizing excess material that might interfere with subsequent restorative bonding procedures.[15] Moreover, this application reduced the additional pressure required for adequate condensation of the MTA, which may have contributed to improved surface hardness and, consequently, enhanced compressive strength of the material.[16]

In partial pulpotomy procedures, the challenge lies in partially removing inflamed coronal pulp tissue while preserving the vitality of the remaining healthy radicular pulp.[17] During this process, achieving hemostasis and placing the HC over a wider exposure area can be technically demanding, particularly in posterior teeth. In this case report, a relatively larger volume of MTA needed to be placed over a broader exposure area during partial pulpotomy, which can be considered as technically challenging—especially in posterior teeth and distal regions where access and visibility were limited. The MAP VPT system effectively addressed these challenges by enabling the precise and uniform delivery of MTA directly onto the exposed pulp surface without the need for additional transfer steps. This single and controlled application not only reduced the risk of contamination and material loss but also shortened the operative time while maintaining clinical reliability.

Compared with partial pulpotomy procedures, total pulpotomy requires the placement of a greater volume of HC to achieve complete and hermetic coverage of the entire pulpal floor. The increased cavity dimensions inherently complicate the controlled delivery and adaptation of the material, making precise placement a critical determinant of success.[18] In the present case, the MAP VPT system facilitated the efficient and accurate delivery of an adequate volume of MTA in a single-controlled application. Owing to its specially engineered tip with an enlarged internal diameter, the system allowed for smooth and uniform placement of the material while minimizing procedural time and material waste. This refined delivery approach ensured consistent adaptation of the MTA to the pulpal floor, promoting a dense and stable coronal seal—an essential prerequisite for the long-term clinical success and biological integrity of total pulpotomy procedures.

Despite the encouraging clinical and radiographic findings, the limitations of the present study should be carefully considered. In the scope of the study design, the relatively short follow-up periods (ranging from 6 to 8 months) restrict the ability to draw definitive conclusions regarding the long-term prognosis of the treated teeth. Although the primary objective of this case series was not to evaluate long-term treatment success, but rather to provide an initial clinical insight into MAP VPT's practical usability, handling characteristics, and potential procedural advantages in routine clinical practice, such supportive factors may contribute to overall treatment outcome. Therefore, the present report should be considered exploratory or pilot in nature, and its findings should be interpreted with caution. On the side of the MAP VPT system itself, the relatively high cost of the system may limit its accessibility in general dental settings, especially in universities or clinics with restricted budgets. Moreover, it may require operators to develop new handling skills, particularly regarding angulation, pressure control, and material flow management during treatments. Therefore, there is a need for previous training until adequate familiarity and proficiency are achieved. While the MAP VPT system enhances the precision and uniformity of hydraulic cement placement, the ultimate success of vital pulp treatments remains dependent on other critical parameters, such as accurate case selection, effective hemostasis, maintenance of asepsis, and a well-sealed final restoration. Thus, the system should be considered an adjunct tool that supports optimal material delivery rather than a substitute for sound clinical judgment and biologically based treatment principles.

4. Conclusion

The MAP VPT system could serve as a supportive adjunct for the controlled delivery of HCs during different VPTs. While it can enhance handling convenience and procedural efficiency, treatment success remains dependent on appropriate case selection, effective hemostasis, asepsis, and an adequate coronal seal. Studies with larger patient cohorts and extended follow-up periods are warranted to further validate these findings and to compare the system's efficiency and outcomes with conventional material placement techniques.

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Acknowledgments
The author would like to thank Mr. Alexandre Mulhauser from Produits Dentaires for kindly providing the prototype of the MAP VPT system before its official launch.

AI Declaration
No generative AI used for writing/analysis/figures.

Conflict of Interest
The author declares no conflicts of interest.

CRediT Author Statement
S. N.U. : Conceptualization, Methodology, Investigation, Data curation, Writing – original draft, Visualization

Data Availability Statement
All data are included in the article and its supplements.

Ethics Approval
Not applicable.

Funding
No external funding.

How to cite this article:

Usta SN. Clinical Applications of the Newly Generated MAP VPT System in Different Vital Pulp Therapies: A Case Series. *J Endod Restor Dent*. 2026; 4(1):22-26.
doi: 10.5281/zenodo.18586004