

# Treatment Outcomes of 4 Vital Pulp Therapies in Mature Molars



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## Abstract

**Introduction:** Vital pulp therapy (VPT) is a biological approach to minimally invasive endodontics. This randomized clinical trial aimed to evaluate and compare clinical and radiographic success of 4 VPTs (indirect pulp capping [IPC], direct pulp capping [DPC], miniature pulpotomy [MP], and full pulpotomy [FP]) using calcium-enriched mixture cement for deep caries management of mature permanent molars including teeth with clinical signs of irreversible pulpitis and the presence of apical periodontitis. **Methods:** Blinded participants ( $N = 302$ ) were randomly allocated to 4 study arms. Random allocation was disregarded when visible pulp exposures did not happen after complete caries removal and the tooth was transferred to the IPC arm. Pre- and intraoperative data including vitality test results, pulpal/periapical status, and exposure type/location were recorded. Pain was measured using a numeric rating scale before treatment initiation up to 1 week postoperatively. Participants were followed up for 1 year. **Results:** The groups were homogenous in terms of age, sex, marital status, education, and practitioner; pre- and intraoperative conditions were similar in all arms and did not affect the long-term success. Preoperative pain and apical periodontitis were significantly different among arms ( $P < .05$ ); however, it was not the case when the IPC group was excluded. After baseline pain adjustment, pain relief was continuous with similar patterns in all treatment groups. The 3- and 12-month success rates of the VPT techniques were comparable in the IPC (98.7% and 100%, respectively), DPC (98.4% and 94.7%, respectively), MP (98.4% and 91.4%, respectively), and FP (93.5% and 95.5%, respectively) arms, respectively ( $P > .05$ ). **Conclusions:** In deep caries management of mature permanent molars, the 4 VPTs were associated with favorable/comparable clinical and radiographic outcomes. The pulpal and periapical status as well as pulpal exposure type/location had no effect on treatment outcomes. (*J Endod* 2018;44:529–535)

## Key Words

Calcium-enriched mixture, CEM cement, endodontics, periapical periodontitis, pulp capping, pulpitis, pulpotomy, randomized controlled trial

The aims of vital pulp therapy (VPT) include the maintenance of vitality and preservation of the remaining pulp for adequate structural/functional healing of the pulp-dentin complex (1, 2). The key point in the success of VPT is continued vitality of the tooth, especially the presence of sufficient blood supply to advance

(3). Vital permanent teeth irrespective of their signs/symptoms of irreversible pulpitis and the presence of apical periodontitis may indeed be candidates for VPT (4–6).

In clinical practice, VPT is an umbrella term for pulp capping (direct/indirect) or pulpotomy (miniature/partial/complete) (7, 8). Indirect pulp capping (IPC) administers a capping material covering the affected dentin over the unexposed pulp; during direct pulp capping (DPC), the covering agent is placed over the exposed pulp. Pulpotomy involves the removal of a minute amount (miniature pulpotomy [MP]) of the coronal pulp up to complete amputation of the coronal pulp (full pulpotomy [FP]) followed by direct coverage of the remaining pulp tissue.

Pulp capping agents should provide a suitable environment to promote regeneration of the dentin-pulp complex and be biocompatible, nontoxic, and antibacterial (9) to induce differentiation of odontoblastlike cells (10). In the new millennium, calcium silicate-based biomaterials such as mineral trioxide aggregate (MTA) and calcium-enriched mixture (CEM) cement have been widely used because of their biocompatibility and adequate properties (2, 11, 12).

CEM as a calcium silicate-based cement is a hydraulic and tooth-colored endodontic biomaterial. The cement has similar clinical applications but dissimilar chemical, physical, and biological properties as MTA (12). CEM is inexpensive and user-friendly and has no discoloration potential (13). *In vitro* studies on MTA and CEM cement have revealed that both endodontic biomaterials are capable of inducing hard tissue formation (ie, cementogenesis [14], dentinogenesis [15], and osteogenesis [16]).

## Significance

For the first time, this randomized clinical trial has provided evidence that various VPTs had a similar promising performance in the management of vital mature teeth with clinical signs of irreversible pulpitis and/or the presence of apical periodontitis. These biological approaches as realistic alternatives in endodontics were highly effective and can be recommended for universal practice. In addition, CEM biomaterial can be used for such treatments.

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