A Review of Criteria for the Evaluation of Pulpotomy Outcomes in Mature Permanent Teeth

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Abstract

Introduction: During the past decade, with a view to understanding pulp biology better and developing bioactive materials, pulpotomy has been reinvestigated as a definitive treatment in mature permanent teeth. Pulp chamber pulpotomy or coronal pulpotomy is widely used in deciduous and immature permanent teeth, and there is thus a need for trials to evaluate the outcome of pulpotomy as a therapeutic procedure on mature permanent teeth in accordance with Good Clinical Practice guidelines. This study aimed to review publications reporting the outcomes of pulpotomy when indicated as a definitive treatment in mature permanent teeth and to discuss the relevance of the criteria that could be used in clinical practice or research. **Methods:** A review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist was conducted on publications found by both PubMed and backward research. **Results:** Seven clinical trials, 9 cohort studies, and 15 cases reports have been included. Overall, goals, criteria for inclusion, and criteria for outcomes of pulpotomy varied among studies. The relevance and the reliability of the success or failure criteria of pulpotomy were discussed regarding the possible evolution of the radicular pulpal status that could be expected after pulpotomy. Finally, criteria for the evaluation of the outcome of pulpotomy are proposed. **Conclusions:** The use of standardized outcome criteria would facilitate further meta-analyses, aiming to assess whether pulpotomy should be considered as a true alternative therapy to root treatment. *(J Endod 2016;42:1167–1174)*

Key Words

Criteria, endodontics, outcomes, permanent Teeth, pulpotomy, review

Significance

Pulpotomy in permanent teeth is a domain of interests in endodontics, but few studies have been conducted in clinical research. This review seeks to help clinicians and researchers to identify the numerous factors affecting the outcome of pulpotomy.

Pulp amputation, or pulpotomy, is defined as a procedure in which part of an exposed vital pulp is removed, usually as a means of preserving the vitality and function of the remaining part (1). The rationale is to remove the portion of the pulp tissue that has undergone degenerative and irreversible changes and to leave behind healthy and vital tissue (2). Pulpotomy is essentially indicated as a treatment of normal pulp or reversible pulpitis associated with a carious lesion or after traumatic pulp exposure in primary teeth (3) and immature permanent teeth (4). In mature permanent teeth, full pulpotomy is actually only indicated as an emergency (routine) procedure before root canal treatment (RCT) (5, 6).

During the last decade, in relation with a better understanding of pulp biology and the development of bioactive materials, pulpotomy has been reinvestigated as a definitive treatment of mature permanent teeth. The advantages of maintaining pulp vitality are numerous; this strategy seeks to keep all the functions of pulp, especially the vascularization, innervation, immunocompetency, neurosensory, and proprioceptive functions of the tooth. The dentin-pulp complex would also continue to protect itself by stimulating the formation of tertiary dentin or a mineralized barrier against aggressions. Moreover, pulpotomy is technically less complicated, less time-consuming, and less expensive than RCT and could be indicated in difficult endodontic cases (7). If pulpotomy were considered an alternative to RCT, it would be necessary to define the outcome of pulpotomy and the criteria for evaluating the long-term results of pulpotomy in the same perspective as RCT.

This study aimed to review publications on pulpotomy as a definitive treatment in mature permanent teeth and to discuss the criteria that are necessary to evaluate the outcomes of pulpotomy for both clinical practice and further research.

Materials and Methods

A review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist was undertaken. The flow diagram of included records is shown in Figure 1. On November 16, 2015, 219 titles listed in PubMed from 1990 to 2015 were systematically selected using the following terms: [PULPOTOMY] AND [PERMANENT] AND [TEETH]. During screening of the abstracts, 2 investigators (M.Z. and M.H.) conducted the research on PubMed independently and for backward

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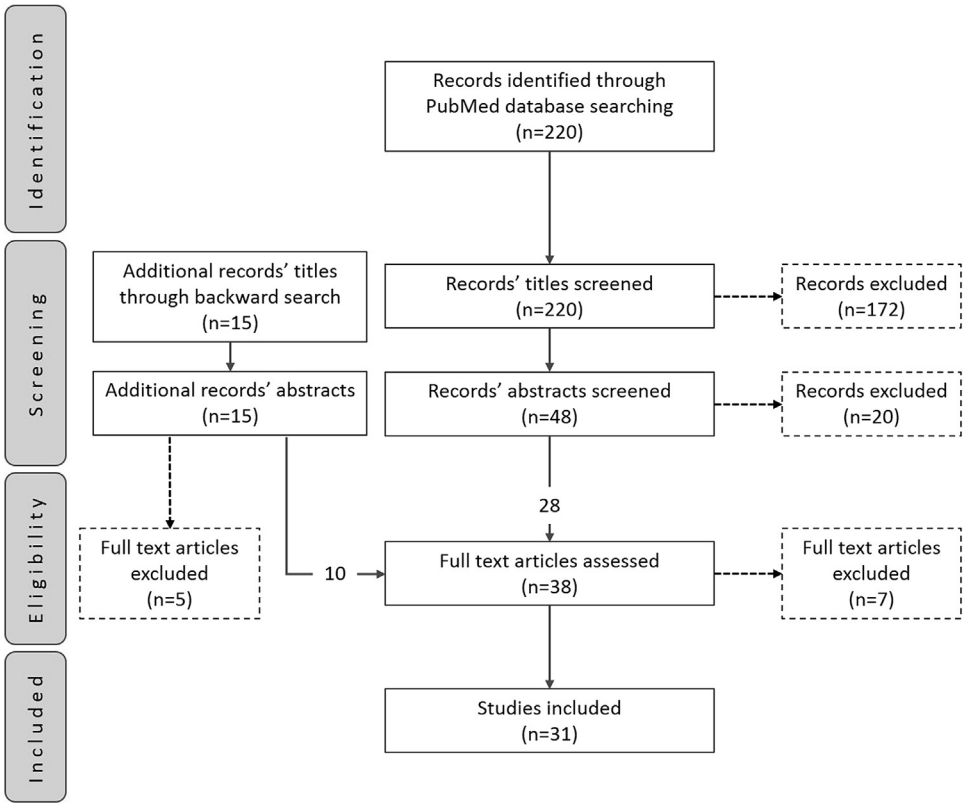

Figure 1. A flow diagram of records.

research. The criteria for exclusion were as follows: not in English; animal and *in vitro* studies; reviews; comments; articles reporting pulpotomies on primary teeth, immature permanent teeth, traumatized teeth, or dens invaginatus; studies on vital pulp capping, partial excavation, or partial pulpotomy; articles related to general issues in pediatric dentistry; studies related to the use of formocresol; articles retracted by the journal's editor; and trials in which the criteria for success or failure of pulpotomies were not reported. At the step of eligibility, all 3 authors agreed to exclude full-text articles that did not report which criteria were used to evaluate the outcomes of pulpotomy.

A first group of 28 articles was selected, and a backward search was performed from the references of these studies, which produced a group of 15 additional articles, 10 of which were eligible. Among the set of 38 eligible articles, the applied exclusion criteria were as follows: articles reporting short-term outcomes (8, 9), studies in which the numbers of immature or immature teeth could not be distinguished (10), *in vitro* studies (11), duplicate reports (12), and 1 review (13). Two articles satisfying the inclusion criteria were published during the submission process of this article. One systematic review was excluded (14), and 1 prospective cohort study was included (15).

Finally, 31 articles were included: 15 case reports or case series (16–30), 9 cohort studies (15, 31–38), and 3 clinical trials and 4 randomized clinical trials (39–45).

Results

Reported Outcomes of Pulpotomy

This review included 7 observational cohort studies and 7 trials that provided the success rate for pulpotomy, which varied from 42%–100% (Table 1), whereas all 15 case series reported success. Meta-analysis was not undertaken because of the lack of common criteria to characterize the indications and outcomes of pulpotomy. The problems questioned by the included studies differed greatly in terms of the initial pulpal diagnosis, material for pulp capping, interim restorative treatment, duration of the follow-up period, and the criteria for the outcome of pulpotomy (Table 1). In this situation, the formulation of a common answerable question (according to the Patient/Intervention/Comparator/Outcome statement) seems to be risky because only 2 studies were conducted under equivalent conditions (35, 37) but with small groups.

Goals of the Studies

Overall, the studies had 3 goals. In the first group, the outcomes after the use of different pulp capping materials were compared (18, 31, 39, 43), whereas other studies described the outcome of pulpotomy realized with a single material (16, 17, 22–24, 28, 30, 40, 44, 45). Different types of material were tested including bioactive materials such as calcium hydroxide with or without corticosteroid medications (18, 31, 32, 39, 40), materials such as calcium-enriched mixture cement (18, 23, 43, 44), mineral trioxide aggregate (16–18, 24, 30, 43), and Biodentine (Septodont, Saint-Maur-des-Fossés, France) (28). Certain authors tested a biological matrix platelet-rich fibrin membrane obtained after centrifugation of the patients' own withdrawn blood (25, 29). Finally, the last group tested the impact of a new antiseptic material named *Allium sativum* oil (19).

In a second group of studies, authors tested unusual clinical indications of pulp vitality therapy such as reversible pulpitis associated with an apical radiolucency (20, 21, 33), both acute and chronic irreversible pathologies. In particular, studies investigated whether hyperplasic pulpitis (32, 33), internal resorption (27), and osteosclerosis (33) could be treated with pulpotomy, whereas such diseases were indications for RCT.