Vital pulp therapy in vital permanent teeth with cariously exposed pulp: a systematic review

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CRD summary
This review concluded that vital pulp therapy should be considered as an alternative to pulpectomy for vital permanent teeth with exposed pulp due to caries. Partial or full pulpotomy were more reliable than direct pulp capping. This was based on an informal indirect comparison. Due to the quality of the evidence, the reliability of the conclusions is unclear.

Authors' objectives
To assess the clinical and radiographic success of three treatments for vital permanent teeth, with exposed pulp due to caries: direct pulp capping, partial pulpotomy, or full pulpotomy.

Searching
PubMed and The Cochrane Library were searched for articles from 1950 to May 2010. Five relevant journals were handsearched. References from seven relevant textbooks and from identified articles were checked. Search terms were reported. Only studies reported in English were eligible for inclusion.

Study selection
Studies that assessed calcium hydroxide or mineral trioxide aggregate in direct pulp capping, partial pulpotomy or full pulpotomy, for the treatment of vital permanent teeth with exposed pulp, due to caries, were eligible. Studies had to evaluate success based on clinical and radiographic assessment, and provide sufficient data to determine the success rate. A minimum of six months of follow-up was required.

The publication date, for the included studies, ranged from 1971 to 2010 for direct pulp capping, 1989 to 2007 for partial pulpotomy, and 1993 to 2006 for full pulpotomy. Patient age ranged from six to 10 years for direct pulp capping, six to 27 years for partial pulpotomy, and six to 70 years for full pulpotomy. Few characteristics of the patients or teeth, in the included studies, were reported.

Two reviewers independently assessed the studies for inclusion.

Assessment of study quality
Studies were appraised, using a 17-point scale published by Torabinejad and colleagues, on a combination of study design and individual methodological criteria. They were assigned a level of evidence.

It was not clear how many reviewers were involved in this assessment.

Data extraction
The success rates, with 95% confidence intervals, were extracted or calculated, using standardised evidence tables. It was not clear how many reviewers were involved in data extraction.

Methods of synthesis
Weighted pooled success rates, with 95% confidence intervals, for each treatment, were calculated, using a DerSimonian and Laird random-effects method, for follow-up of between six months and one year, one to two years, two to three years, and over three years. Direct and indirect comparisons of success rates, using calcium hydroxide versus mineral trioxide aggregate, were carried out for each method; each direct comparison was based on one study. An indirect comparison was carried out separately for teeth with closed and teeth with opened apex. No direct comparison between the three assessed interventions was conducted.

Results of the review
Twenty-three studies were included in the review. Data were reported for 1,385 teeth; 996 received direct pulp capping, 199 received partial pulpotomy, and 190 received full pulpotomy. There were four randomised controlled trials (RCTs), five cohort studies, and 14 case series. Follow-up ranged from one to 10 years for direct pulp capping, one to three
years for partial pulpotomy, and one to seven years for full pulpotomy. Mean quality scores were between 8 and 10, for each treatment.

The weighted pooled success rates ranged from 72.9% (95% CI 49.6 to 96.3) for direct pulp capping after three years to 99.4% (95.6 to 103.2) for partial pulpotomy after three years; the rate for full pulpotomy after three years was 99.3% (94.5 to 104.1). The data indicated that the success rates remained high and stable from six months to over three years, for full and partial pulpotomy, but rose to 95.4% (95% CI 90.4 to 100.5) at one to two years, then declined, with direct pulp capping. The full results for each procedure at each follow-up were reported.

The direct comparisons showed no significant difference between procedures using calcium hydroxide and those using mineral trioxide aggregate, for each treatment. Indirect comparisons favoured mineral trioxide aggregate for direct pulp capping, but calcium hydroxide for partial pulpotomy, with no significant difference for full pulpotomy. For direct pulp capping, there were statistically significant higher success rates for teeth with an open apex (94.5%) than for those with a closed apex (69.2%); success rates did not differ significantly between closed and open apices, for partial or full pulpotomy.

**Authors' conclusions**
Vital pulp therapy should be considered as an alternative to pulpectomy for vital permanent teeth, with exposed pulp due to caries. Partial pulpotomy and full pulpotomy were more reliable than direct pulp capping.

**CRD commentary**
The review question was clear and supported by specific inclusion criteria. The search was adequate. The authors used relevant criteria to assess the quality of the studies; points were also awarded for study design. Using this composite measure most studies were considered to be of low-to-moderate quality. Two independent reviewers selected studies; it was not clear whether this method of reducing the risk of bias and error was used for other stages of the review.

The synthesis appears to have been appropriate, but the conclusions on the relative stability of the interventions over time were not based on statistical comparisons of the data. The authors' statement that this comparison may not be appropriate was reasonable, particularly given the differing ages of patients and variations in publication dates. Most included studies were observational, with low-to-moderate quality. Direct comparisons between interventions were not possible.

The findings seem to support the conclusion that vital pulp therapy should be considered; the relative predictability of survival across interventions, relied on visual inspection of the data sets. There was considerable uncertainty about the reliability of the findings, due to the evidence available.

**Implications of the review for practice and research**
Practice: The authors stated that vital pulp therapy should be considered as an alternative to pulpectomy, for vital permanent teeth with exposed pulp due to caries.

Research: The authors stated that more well-designed observational studies of the methods of treating vital permanent teeth were needed.

**Funding**
Support received from Chulalongkorn University, Bangkok, Thailand.

**Bibliographic details**

**PubMedID**
21496652

**DOI**
10.1016/j.joen.2010.12.004
Original Paper URL

Indexing Status
Subject indexing assigned by NLM

MeSH
Dental Caries /complications; Dental Pulp Capping /methods; Dental Pulp Exposure /therapy; Follow-Up Studies; Humans; Pulp Capping and Pulpectomy Agents /therapeutic use; Pulpotomy /methods; Treatment Outcome

AccessionNumber
12011006188

Date bibliographic record published
30/03/2012

Date abstract record published
19/09/2013

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.