A systematic review of the effectiveness of anticalculus dentifrices

Netuveli G S, Sheiham A

CRD summary
The review authors concluded that anticalculus dentifrices containing pyrophosphates, zinc compounds and/or copolymer significantly reduced dental calculus. Not all of the conclusions were supported by the results as some concentrations of the active agents did not show statistically significant reductions in calculus. Missing details of the quality and results of each study make it difficult to assess the reliability of the pooled results.

Authors' objectives
To evaluate the effectiveness of commercially available anticalculus dentifrices.

Searching
MEDLINE, EMBASE, CINAHL, PsycINFO, PREMEDLINE and HealthSTAR were searched from 1966 to June 2002; the search terms were reported. The authors also searched an online database of the U.S. Patent and Trademark Office for unpublished studies, screened five named journals, checked the reference lists of identified studies, and contacted the authors of relevant studies for details of any additional studies.

Study selection
Study designs of evaluations included in the review
Parallel-group, randomised controlled trials (RCTs) that lasted at least 3 months were eligible for inclusion. The duration of the included studies ranged from 3 to 12 months.

Specific interventions included in the review
Studies that compared commercial, currently available, anticalculus dentifrices (pyrophosphates, zinc salts, PVM/MA copolymer and citroxan) with a placebo dentifrice were eligible for inclusion. The included studies evaluated a variety of different concentrations of pyrophosphate dentifrices (1.3%, 3.3% and 5.0%) alone or with copolymers (1.0% and 1.5%); zinc citrate (0.5%, 0.75% and 2.0%); copolymer alone (2.0%); and zinc chloride.

Participants included in the review
Inclusion criteria for the participants were not specified. No details of the participants were reported.

Outcomes assessed in the review
Studies that assessed dental calculus using the Volpe-Manhold index (see Other Publications of Related Interest) were eligible for inclusion. The review also assessed adverse effects.

How were decisions on the relevance of primary studies made?
Two reviewers jointly selected studies for inclusion in the review.

Assessment of study quality
Two reviewers jointly assessed study quality by considering the acceptability of study design, analysis, conduct and reporting. Study design was assessed using the following criteria: reporting of minimum treatment difference; sample size calculation; unit of randomisation; method of allocation generation and concealment; blinding of the patient and examiner; comparable test and placebo dentifrices; handling of attrition and drop-outs; statistical methods; and ethical considerations and conflicts of interest.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data
extraction. Cohen's effect sizes (ES) were calculated for each study.

**Methods of synthesis**

How were the studies combined?
The studies were grouped by duration (3, 6 or 12 months) and combined in meta-analyses using a random-effects model (DerSimonian and Laird). Publication bias was assessed using a funnel plot and tested statistically using the Begg and Majumder, and Egger tests.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the Q statistic. The studies were also stratified by active agent and concentration of dentifrice.

**Results of the review**

Thirty-one RCTs (n=4,807) were included in the review.

One study reported a sample size calculation and method of allocation generation. Allocation concealment was adequately described in 4 studies, not mentioned in 3 studies, and indicated in the remaining studies. Blinding of the outcome assessment was adequately described in 4 studies, not mentioned in 2 studies, and indicated in the remaining studies. Blinding of personnel was adequately described in 8 studies and indicated in the remainder.

Studies lasting 3 months (43 comparisons in 27 studies).
Active agents significantly reduced calculus at 3 months compared with the control (ES -0.6, 95% confidence interval, CI: -0.7, -0.4). Statistically significant heterogeneity was found (p<0.0001), but this was no longer significant when the studies were grouped by the active agent (pyrophosphates 5.0%, pyrophosphates 3.3% plus copolymer 1.0%, and zinc citrate 0.5% and 2%). Significant reductions in calculus were seen for most agents except polyphosphates (1 trial), pyrophosphates 1.3% (4 trials) and zinc citrate 0.75% (2 trials). The largest reduction in calculus was obtained through the use of pyrophosphates 1.3% with copolymer 1.5% (5 trials) with an ES of -1.1 (95% CI: -1.7, -0.6).

Studies lasting 6 months (20 comparisons in 14 studies). Active agents significantly reduced calculus at 6 months compared with the control (ES -1.1, 95% CI: -1.5, -0.8). Statistically significant heterogeneity was found (p<0.0001). Results presented according to type of agent all showed statistically significant effects in favour of the active agents.

Studies lasting 12 months (3 studies).
Pyrophosphates 3.3% were associated with significantly reduced calculus compared with the control (ES -11.7, 95% CI: -13.8, -9.7), based on one study. There was no significant difference between pyrophosphates 1% and the control (2 studies).

The funnel plot of ESs for all studies of 3 months' duration was asymmetrical, suggesting the presence of publication bias; this was confirmed by statistically significant Begg and Majumder, and Egger test results.

Twenty studies reported no adverse effects.

**Authors' conclusions**
Anticalculus dentifrices containing pyrophosphates, zinc compounds and/or copolymer are effective in inhibiting calculus formation.

**CRD commentary**
The review addressed a clear question that was defined in terms of the intervention, outcomes and study design; inclusion criteria were not specified for the participants. The strategy undertaken to identify studies was extensive and included attempts to identify unpublished studies; however, the funnel plots and statistical tests suggested the presence
of publication bias. The authors jointly selected studies and assessed validity and this lack of independence might have led to reviewer error and bias, which the authors acknowledged. The methods used to extract the data were not described, so it is not known whether any efforts were made to reduce reviewer errors and bias.

No information about the participants was given; in particular, the severity of calculus at baseline was not reported, which makes it difficult to assess the generalisability of the results. Validity was assessed using specified criteria but the results were not reported for each study and not accounted for when reporting the results. The results of the individual studies were not presented; this makes it difficult to assess the reliability of the pooled results, especially as there was considerable heterogeneity. Stratifying the results by type of agent apparently removed the heterogeneity but, again, the lack of individual results makes it difficult to confirm this. Most of the authors' conclusions appeared to be supported by the results, but not all concentrations of the active agents were associated with statistically significant reductions in calculus.

Implications of the review for practice and research
Practice: The authors stated that since anticalculus dentifrices can vary in their effectiveness, it may be essential to explicitly state the active agents in toothpastes.

Research: The authors stated that future clinical trials should seek to evaluate the benefits of anticalculus dentifrices to the health service. They also stated that the quality of the reporting of clinical trials in dentistry should be improved.

Bibliographic details

PubMedID
15641765

Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
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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.