Commissioning Brief - Background Information

Partial removal of dentinal caries in permanent teeth

This background document provides further information to support applicants for this call. It is intended to summarize what prompted the call and the existing evidence base, including relevant work from the HTA and wider NIHR research portfolio. It was researched and written on the basis of information from a search of relevant sources and databases, and in consultation with a number of experts in the field. Searches and information provided were up to date as of September 2016.

Background information:

Source of topic
Expert suggestion.

Patient group
Dental caries (or dentinal caries, referring to the affected tissue) is described as a breakdown of teeth due to activities of bacteria.

In 2013, 46% of 15 year olds and 34% of 12 year olds had active dental caries in their permanent teeth. 21% of 15 year olds and 19% of 12 year olds had untreated dentinal caries in permanent teeth.

In 2009, just under one third of adults (31%) had obvious dental caries in either the crowns (coronal caries) or roots of their teeth. The prevalence of coronal caries varied with age, with the highest prevalence in adults aged 25 to 34 (36%) compared with those aged 65 to 74 (22%).

Dental caries follows a social gradient. Children from more socially deprived backgrounds are more likely to experience dental caries in their permanent teeth, whilst adults from routine and manual occupation households experience more dental caries than those from managerial and professional occupational households (37% compared with 26%).


NICE and other guidance
No up-to-date guideline for the treatment of dentinal caries was identified.

NICE has a small number of guidelines, but none of these addresses the research question.

- TA92 HealOzone for the treatment of tooth decay (occlusal pit and fissure caries and root caries). July 2005. Last review in May 2014. No new evidence was identified. The guidance was moved to the static list of technology appraisals.

- Other guidance relates to dental checks (recall) - intervals between oral health reviews (CG19, 2004, last reviewed in September 2012), the extraction of wisdom teeth (TA1, 2000), oral health promotion (NG30, December 2015), and oral health improvement for local authorities and their partners (PH55, October 2014). There are also three NICE guidelines on interventional procedures. One of these is
a dental procedure: Mini/micro screw implantation for orthodontic anchorage (IPG238, November 2007).

- Three guidelines are in development: Oral health promotion in the community (anticipated publication: December 2016); Third molars (impacted) - prophylactic removal (review of TA1; anticipated publication June 2017), and Oral health for adults in care homes (anticipated publication July 2016).

Public health England has published prevention guidance:

- Delivering better oral health is an evidence-based toolkit to support dental teams in improving their patient's oral and general health.

The Royal College of Surgeons, Faculty of Dental Surgery published a guideline on

- Diagnosis, Prevention and Management of Dental Erosion (2013), which refers to erosions caused by acids in food, rather than to bacterial causes of caries.

**Current practice and proposed intervention**

*Current practice*

There is currently no overall agreement on management strategies for caries in permanent teeth. Caries lesions are often treated by complete removal of carious dentine and restoration of the resulting cavity. However, this type of management can trigger a 'cascade of reinterventions', threatening the vitality of the pulp and ultimately the survival of the tooth.\(^1\)

The International Caries Consensus Collaboration has recently published new clinical recommendations for carious tissue removal and managing cavitated carious lesions. The Collaboration (which includes leading UK Clinicians) suggests that dentists should manage dental caries in such a way that hard tissues are preserved and teeth retained long-term. 'Controlling the disease in cavitated carious lesions should be attempted using methods which are aimed at biofilm removal or control first. Only when cavitated carious lesions either are noncleansable or can no longer be sealed are restorative interventions indicated.' The Collaboration supports less invasive caries management strategies and suggests, 'for teeth with shallow or moderately deep cavitated lesions, carious tissue removal is performed according to selective removal to firm dentine.'\(^2\)

*Proposed intervention*

There is some evidence to suggest that partial/incomplete caries removal may be an effective management strategy. These techniques have been shown to reduce the risk of accidental pulpal exposure and related complications. They can also help minimise the 'cascade of reinterventions' mentioned above.

Partial caries removal can be performed in a single step procedure, where the caries-affected dentine is sealed under a definitive restoration. Alternatively, a stepwise approach can be taken, with residual caries being left under a temporary excavation after the first step, followed by complete excavation in a second step. However, a step-wise approach carries a higher risk of pulpal exposure.\(^1\)

Partial caries removal is associated with longer retention of natural teeth and it has been argued that it could be cost-effective in the longer term. However, all published evidence so far comes from poor or moderate quality research at high risk of bias.

**Summary of completed research**

*Evidence Synthesis*

One Cochrane review, two other systematic reviews, and one cost-effectiveness analysis were identified. All reviews reported high risk of bias in the included studies, mainly due to lack of masking of participants, operators, staff, and assessors. Follow-up was generally short. The quality of the available evidence was considered moderate to poor. Studies often included primary teeth only.

- Operative caries management in adults and children [Ricketts et al. 2013, UK; update of a previous review 3].

This Cochrane review assessed the effects of stepwise, partial or no dentinal caries removal compared with complete caries removal for the management of dentinal caries in previously unrestored primary and permanent teeth. Searches were undertaken up to 12 December 2012. Parallel group and split-mouth randomised and quasi-randomised controlled trials were eligible for inclusion. Eight trials were included (934 participants and 1372 teeth). Stepwise caries removal resulted in a 56% reduction in incidence of pulp exposure (risk ratio (RR) 0.44, 95% confidence interval (CI) 0.33 to 0.60, P < 0.00001,
I² = 0%) compared to complete caries removal based on moderate quality evidence, with no heterogeneity. Partial caries removal reduced incidence of pulp exposure by 77% compared to complete caries removal (RR 0.23, 95% CI 0.08 to 0.69, P = 0.009, I² = 0%), also based on moderate quality evidence with no evidence of heterogeneity. There was insufficient evidence to determine whether there was a difference in signs and symptoms of pulp disease (RR 0.27, 95% CI 0.05 to 1.60, P = 0.15, I² = 0%, low quality evidence), or restoration failure. There was some moderate evidence of no difference between no dentinal caries removal and complete caries removal, but the evidence came from two very different trials.

All of the included trials were at high risk of bias, although newer trials showed evidence of attempts to minimise bias. Bias came mainly from lack of masking of participants and staff, and, most importantly, of outcome assessors. Limitations also came from incomplete reporting, from the short-term follow-up of the trials (mean follow-up: 1 year) and from study designs.

- **Incomplete Caries Removal: A Systematic Review and Meta-analysis.** [Schwendicke et al. 2013³].

A German Team reviewed randomized controlled trials investigating one- or two-step incomplete compared with complete caries removal. Searches were undertaken up to 2012. The review included 10 RCTs investigating treatments of primary and/or permanent teeth with primary caries lesions that required restoration (1,257 participants). Meta-analysis showed risk reduction for both pulpal exposure (OR [95% CI] 0.31 [0.19-0.49]) and pulpal symptoms (OR 0.58 [0.31-1.10]) for teeth treated with one- or two-step incomplete excavation. Risk of failure seemed to be similar for both complete and incomplete excavation, but data for this outcome were of limited quality and inconclusive (OR 0.97 [0.64-1.46]). There was high heterogeneity and 'very serious' risk of bias in the included studies, mostly due to lack of assessor and participant masking.

- **Limited evidence for main reason for failure of partially excavated and restored teeth.** [Fontana 2014. USA³].

A systematic review by a single author investigated treatment failure in partial caries removal, compared to complete removal. In this review, randomised and non-randomised, controlled and uncontrolled, pro- and retrospective clinical studies (in English or German) that investigated one- or two-step incomplete dentinal caries removal (where caries was >1/2 dentine thickness) were eligible. Searches were carried out up to December 2012. Twenty-nine articles reporting 19 trials (12 RCTs, two controlled trials, five case series and retrospective studies), with a median follow up of 24 months were included. In 11 studies pulpal complications were the main reason for failure and only two studies found more non-pulpal than pulpal failures. Median annual failure rate was 3.8 (interquartile range (IQR): 1.4 to 4.4). From the sub-group analyses, there was significantly lower risk of failure for teeth with one- compared to those with two-step excavation (OR=0.21, 95%CI 0.08 to 0.55) and for those with single compared with multi-surface lesions (OR=0.33, 95%CI 0.16 to 0.67). The author points out that risk of bias varied widely and the quality of the studies was very low.

- **Cost-effectiveness of caries excavations in different risk groups - a micro-simulation study.** [Schwendicke et al. 2014³]

The cost-effectiveness analysis compared three strategies for the treatment of deep caries in high-risk and low-risk patients: selective (one-step incomplete), stepwise (two-step incomplete) and complete excavation. Selective excavation was more effective and less costly than both alternatives regardless of an individual’s risk. All three strategies were less effective and more costly in patients with high compared with low risk, whilst the differences between risk groups were smallest for selective excavation. That the analysis used a mixed public-private payer perspective as is characteristic for Germany. Results of this analysis may not be applicable to the UK setting.

**Primary Research**

We searched for relevant studies that were published after the cut-off dates of the above systematic reviews. However, only studies in primary teeth were identified, but no recently published studies of partial caries removal in permanent teeth.

**Research in progress**

**Evidence Synthesis**

None identified.
Primary Research

- NCT02286388 Multicenter Trial Comparing One-step Partial Caries Removal to Complete Caries Removal for the Treatment of Deep Carious Lesions in Permanent Teeth. (DECAT: DEep CAries Treatment). Target sample size: 464. Eligibility criteria: aged 8-80 years; mature permanent posterior tooth, with a deep (primary or secondary) at least proximal and/or occlusal carious lesion presenting a residual dentin thickness with no continuity between the carious cavity and the pulp chamber). Estimated completion date: December 2016. France.

NIHR Evaluation Trials and Studies (NETS) research

NETS have funded a number of projects in the field of dentistry. None of these answers the research question.

ACTIVE PROJECTS

- HS&DR 13/33/45: The value and cost of different forms of information on oral health status and risk given to patients following a check-up in dental practice. Active. Anticipated completion: 28/02/2017.

IN EDITORIAL

- HTA 08/14/19: A randomised control trial to measure the effects and costs of a dental caries prevention regime for young children attending primary care dental services (Northern Ireland Caries Prevention In Practice Trial - NIC-PIP trial). In Editorial. Anticipated publication: September 2016.
- HTA 08/104/04: Seal or Varnish? A randomised trial to determine the relative cost and effectiveness of pit and fissure sealants and fluoride varnish in preventing dental decay. In Editorial. Anticipated publication: April 2017. (A randomised trial in which children will receive either fissure sealants on their first permanent molars or fluoride varnish).

COMPLETE/PUBLISHED

- HTA 06/35/05: INTERVAL Dental recalls trial (Investigation of NICE Technologies for Enabling Risk-Variable-Adjusted-Length Dental Recalls Trial) - a feasibility study and follow on. Complete, no publication required.

References


