

Selective removal compared to complete removal for deep carious lesions

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Abstract

Introduction

Dental caries have been conventionally managed by non-selective removal of carious tissue (total complete removal); however, the adverse effects of this procedure have promoted the use of conservative caries removal techniques (selective removal), but there is still controversy regarding its effectiveness.

Methods

We searched in Epistemonikos, the largest database of systematic reviews in health, which is maintained by screening multiple information sources, including MEDLINE, EMBASE, Cochrane, among others. We extracted data from the systematic reviews, reanalyzed data of primary studies, conducted a meta-analysis and generated a summary of findings table using the GRADE approach.

Results and conclusions

We identified seven systematic reviews including seven studies overall, of which all were randomized trials. We concluded that selective caries removal may decrease the need for root canal treatment and the risk of pulp exposure in teeth with deep caries, but the certainty of the evidence is low. It is not clear whether the selective removal of caries reduces the risk of appearance of signs and symptoms of pulp disease and the risk of restorations failure, as the certainty of the evidence is very low.

Problem

Dental caries is the most prevalent dental disease worldwide¹. Traditionally, its treatment involves non-selective (complete) removal of carious and demineralized tissue, and subsequent restoration of the dental piece². However, this dental preparation technique has been questioned in recent years for the associated adverse effects, such as pulp exposure and development of pulp disease^{2,3}.

Consequently, conservative techniques have emerged as an alternative for the treatment of deep caries. One of them consists of the selective removal of carious tissue, in order to preserve as much dental structure as possible and so avoiding adverse effects⁴. This technique has been defined in various ways in the literature, with discrepancies in excavation depth and clinical removal criteria.

The most accepted definition is the one proposed by the International Caries Consensus Collaboration (ICCC), which defines selective removal as the excavation technique in which peripheral dentin is removed until only hard dentin is left, while the pulp wall is excavated until reaching firm or soft dentine ⁵.

However, it has been suggested that this technique would lead to restoration failures, so its use remains controversial ⁶. This summary aims to evaluate the effectiveness and safety of selective caries removal compared to complete removal.

Key messages

- Selective caries removal may decrease the need for root canal treatment and the risk of pulp exposure in teeth with deep caries (low certainty of evidence)
- We are uncertain whether selective caries removal decreases the risk of signs and symptoms of pulp disease and the risk of failure of restorations, as the certainty of the evidence has been assessed as very low.

Methods

We searched in Epistemonikos, the largest database of systematic reviews in health, which is maintained by screening multiple information sources, including MEDLINE, EMBASE, Cochrane, among others, to identify systematic reviews and their included primary studies. We extracted data from the identified reviews and re-analyzed data from primary studies included in those reviews. With this information, we generated a structured summary denominated FRISBEE (Friendly Summary of Body of Evidence using Epistemonikos) using a pre-established format, which includes key messages, a summary of the body of evidence (presented as an evidence matrix in Epistemonikos), meta-analysis of the total of studies when it is possible, a summary of findings table following the GRADE approach and a table of other considerations for decision-making.

About the body of evidence for this question

What is the evidence. See evidence matrix in Epistemonikos later	We found seven systematic reviews ^{4,7-12} which included seven primary studies overall, reported in nine references ¹³⁻²¹ , all of which correspond to randomized trials.
What types of patients were included*	Of the seven trials, five included only children (3 to 11 years old) ^{13-15,18,20} and two included children and adolescents (4 to 17 years old) ^{17,19} . Four included only temporary teeth ^{13,14,17,19} , one trial included only permanent teeth ¹⁹ , and two both dentitions ^{13,17} . Regarding the extent of caries, all trials included only deep tooth decay, excluding those lesions circumscribed only to enamel. Five trials included occlusal and proximal caries ^{13,14,17,18,20} , while two included only occlusal caries ^{15,19} . Finally, all trials excluded patients with irreversible pulp symptoms and/or apical lesion prior to inclusion ^{13-15,17-20} .
What types of interventions were included*	All trials compared the selective removal of deep dental caries against conventional treatment (complete removal). Selective removal was described in various ways by the different trials, but in general it was defined as the excavation of the remaining dentin from the floor of the cavity near the pulp, soft to the touch, of sticky consistency and soft to the probing procedure ⁸ . Complete removal was described as the excavation of the remaining dentin from the floor of the cavity near the pulp, until a hard touch consistency was reached ⁸ . None of the reviews included information on the instruments used or the depth of excavation.
What types of outcomes were measured	The trials measured multiple outcomes, which were pooled by the systematic reviews as follows: <ul style="list-style-type: none"> • Need for root treatment • Pulp exposure • Signs or symptoms of pulp disease • Failure of restoration <p>The follow-up ranged between 6^{15,17,18,20} and 24 months^{13,14,19}.</p>

* Information about primary studies is not extracted directly from primary studies but from identified systematic reviews, unless otherwise stated.

Summary of findings

The information on the effects of selective caries removal is based on seven randomized trials that included 570 patients.

Regarding safety-related outcomes, only one trial reported the events needing root canal treatment (48 patients, 120 teeth)¹⁴, four trials reported the events of pulp exposure (477 patients, 489 teeth)^{14,15,17,18} and six analyzed the signs or symptoms of pulp disease (526 patients, 555 teeth)^{14,15,17-20}. With regard to effectiveness, all trials evaluated the events of restoration failure (570 patients, 641 teeth)^{13-15,17-20}.

The summary of findings is as follows:

- Selective caries removal may decrease the need for root canal treatment in teeth with deep caries (low certainty of the evidence).
- Selective caries removal may decrease the risk of pulp exposure in teeth with deep caries (low certainty of the evidence).
- We are uncertain whether selective caries removal decreases the risk of the appearance of signs and symptoms of pulp disease as the certainty of the evidence has been assessed as very low.
- We are uncertain whether selective caries removal decreases the risk of restoration failure as the certainty of the evidence has been assessed as very low.

Selective removal compared with non-selective (complete) removal for the management of deep tooth decay				
Patients	Patients with deep tooth decay.			
Intervention	Selective caries removal.			
Comparison	Non-selective (complete) caries removal.			
Outcome	Absolute effect*		Relative effect (95% CI)	Certainty of evidence (GRADE)
	WITH complete removal	WITH selective removal		
	Difference: teeth per 1000			
Need of root canal treatment	263 per 1000	16 per 1000	RR 0.06 (0.01 to 0.42)	⊕⊕○○ ^{1,2} Low
	Difference: 247 less (Margin of error: 261 to 153 less)			
Pulp exposure	149 per 1000	22 per 1000	RR 0.15 (0.06 to 0.36)	⊕⊕○○ ^{1,3} Low
	Difference: 127 less (Margin of error: 140 to 95 less)			
Signs or symptoms of pulp disease	34 per 1000	28 per 1000	RR 0.83 (0.34 to 2.03)	⊕○○○ ^{1,2,4} Very low
	Difference: 6 less (Margin of error: 22 less to 35 more)			
Restoration failure	127 per 1000	115 per 1000	RR 0.91 (0.59 to 1.42)	⊕○○○ ^{1,2,4} Very low
	Difference: 12 less (Margin of error: 52 less to 53 more)			

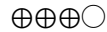
Margin of error: 95% confidence interval (CI).
RR: Risk ratio.
GRADE: Evidence grades of the GRADE Working Group (see later).
*The risk **WITH complete removal** is based on the risk in the control group of the trials. The risk **WITH selective removal** (and its margin of error) is calculated from relative effect (and its margin of error).
¹ The certainty of the evidence was downgraded in one level for risk of bias since in most of the included trials the generation of the randomization sequence and its concealment was not clear. In addition, several trials were not blinded.
² The certainty of the evidence was downgraded in one level for imprecision, since at each end of the confidence interval would lead to different conclusions. In the case of “need of root canal treatment” outcome, it was decided to decrease one certainty of evidence as it corresponds to one single study, which is expected to be inaccurate.
³ The certainty of evidence was downgraded one level for indirect evidence, as it corresponds to a surrogate outcome.
⁴ The certainty of evidence was downgraded one level for inconsistency, as the different studies show contradictory results.

Follow the link to access the interactive version of this table ([Interactive Summary of Findings - iSoF](#))

About the certainty of the evidence (GRADE)*



High: This research provides a very good indication of the likely effect. The likelihood that the effect will be substantially different† is low.



Moderate: This research provides a good indication of the likely effect. The likelihood that the effect will be substantially different† is moderate.



Low: This research provides some indication of the likely effect. However, the likelihood that it will be substantially different† is high.



Very low: This research does not provide a reliable indication of the likely effect. The likelihood that the effect will be substantially different† is very high.

* This concept is also called 'quality of the evidence' or 'confidence in effect estimates'.

† Substantially different = a large enough difference that it might affect a decision

Other considerations for decision-making

To whom this evidence does and does not apply

The results of this summary are widely applicable to people with deep tooth decay in temporary and/or permanent teeth.

Even though the participants in the trials did not include adults or adolescents over 17 years, there are no compelling clinical reasons for not applying the evidence to these groups.

About the outcomes included in this summary

The outcomes selected are those considered critical for decision-making according to the opinion of the authors of this summary, which coincide in general with those presented in the systematic reviews identified.

The "pulp exposure" outcome was included in the summary of findings table because it is a relevant outcome for clinical experts, even when it is an intermediate outcome for the need of root canal treatment.

The "need of root canal treatment" outcome is critical for health decision-making as it involves performing a more complex and expensive additional procedure for the patient.

It is necessary to establish main outcomes (core set outcomes) for clinical trials on caries management, including long-term effectiveness measures (survival of restoration) and patient values and preferences.

Balance between benefits and risks, and certainty of the evidence

The evidence presented in this summary shows a possible benefit in the need of root canal treatment and the risk of pulp exposure outcomes. However, there is uncertainty about the possible risk of selective removal in relation to the occurrence of signs and symptoms of pulp disease and restoration failure.

On the other hand, the duration of the follow-up of the included studies (6 to 24 months) makes it difficult to measure the long-term adverse effects of both interventions.

It is not possible to determine the balance between benefits and risks between selective and complete removal because the certainty of evidence was low or very low for reported outcomes.

Resource considerations

None of the systematic reviews considered an economic analysis for each intervention. However, selective caries removal could reduce operating costs and the total cost of dental treatment as it prevents adverse events that will require new and more expensive interventions⁴.

What would patients and their doctors think about this intervention

Most patients would prefer complete caries removal over selective removal. This preference is marked by the quality of the treatment, the sociodemographic characteristics, the personality of the patient, and previous dental experiences²².

There is evidence that almost half of dentists prefer the use of conventional techniques such as non-selective removal, in the management of deep tooth decay. However, in recent years this preference tends to decrease, raising the preference for conservative removal techniques⁴.

Taking into account the results of this summary, patients and dentists are expected to be in favor of selective caries removal, due to the importance of the expected benefits of this technique in relation to its possible harms.

Differences between this summary and other sources

The conclusions of this summary coincide with those of the seven systematic reviews identified^{4,6-12}, which consider that selective removal decreases the risk of pulp exposure. In addition, they declare that there is uncertainty about the outcome of restoration failure and signs of pulp disease.

The results of this summary also coincide with the recommendations of the guideline for clinical practice on restorative dentistry of the American Academy of Pediatric Dentistry²³.

Could this evidence change in the future?

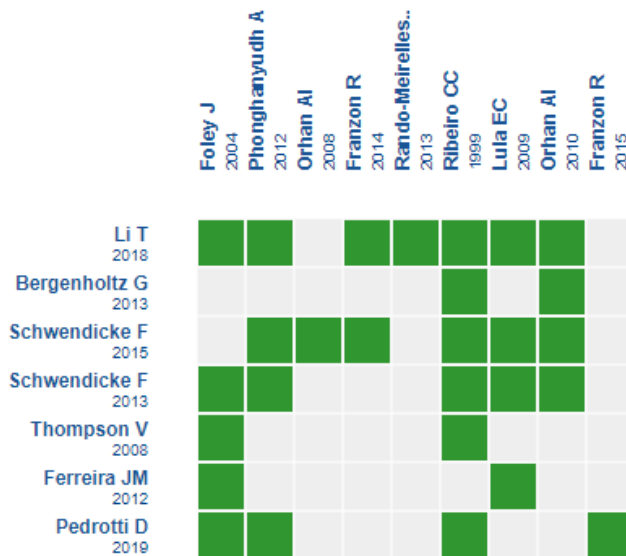
It is very likely that future research will modify the conclusion of this summary, due to the low certainty of the available evidence.

We identified one ongoing randomized trial²⁴ in the International Clinical Trials Registry Platform of the World Health Organization that could yield relevant data for the outcome of pulp signs and symptoms.

We did not identify any ongoing systematic review in the International prospective register of systematic reviews (PROSPERO) of the National Institute for Health Research.

How we conducted this summary

Using automated and collaborative means, we compiled all the relevant evidence for the question of interest and we present it as a matrix of evidence.



Follow the link to access the interactive version: [Selective removal versus complete removal of deep caries lesions.](#)

References

- Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. Bull World Health Organ. 2005 Sep;83(9):661-9. | PubMed |
- White JM, Eakle WS. Rationale and treatment approach in minimally invasive dentistry. J Am Dent Assoc. 2000 Jun;131 Suppl:13S-19S. | PubMed |
- Banerjee A. Minimal intervention dentistry: part 7. Minimally invasive operative caries management: rationale and techniques. Br Dent J. 2013 Feb;214(3):107-11. | CrossRef | PubMed |
- Schwendicke F, Frencken JE, Bjørndal L, Maltz M, Manton DJ, Ricketts D, et al. Managing Carious Lesions: Consensus Recommendations on Carious Tissue Removal. Adv Dent es. 2016 May;28(2):58-67. | CrossRef | PubMed |
- Schwendicke F, Göstemeyer G. Understanding dentists' management of deep carious lesions in permanent teeth: a systematic review and meta-analysis. Implement Sci. 2016 Oct 19;11(1):142. | PubMed |
- Li T, Zhai X, Song F, Zhu H. Selective versus non-selective removal for dental caries: a systematic review and meta-analysis. Acta Odontol Scand. 2018 Mar;76(2):135-140. | CrossRef | PubMed |
- Bergenholtz G, Axelsson S, Davidson T, Frisk F, Hakeberg M, Kvist T, et al. Treatment of pulps in teeth affected by deep caries - A systematic review of the literature. Singapore Dent J. 2013 Dec;34(1):1-12. | CrossRef | PubMed |
- Schwendicke F, Paris S, Tu YK. Effects of using different criteria for caries removal: a systematic review and network meta-analysis. J Dent. 2015 Jan;43(1):1-15. | CrossRef | PubMed |
- Schwendicke F, Dörfer CE, Paris S. Incomplete caries removal: a systematic review and meta-analysis. J Dent Res. 2013 Apr;92(4):306-14. | CrossRef | PubMed |
- Thompson V, Craig RG, Curro FA, Green WS, Ship JA. Treatment of deep carious lesions by complete excavation or partial removal: a critical review. J Am Dent Assoc. 2008 Jun;139(6):705-12. | PubMed |

Notes

The upper portion of the matrix of evidence will display a warning of “new evidence” if new systematic reviews are published after the publication of this summary. Even though the project considers the periodical update of these summaries, users are invited to comment in *Medwave* or to contact the authors through email if they find new evidence and the summary should be updated earlier.

After creating an account in Epistemonikos, users will be able to save the matrixes and to receive automated notifications any time new evidence potentially relevant for the question appears.

This article is part of the Epistemonikos Evidence Synthesis project. It is elaborated with a pre-established methodology, following rigorous methodological standards and internal peer review process. Each of these articles corresponds to a summary, denominated FRISBEE (Friendly Summary of Body of Evidence using Epistemonikos), whose main objective is to synthesize the body of evidence for a specific question, with a friendly format to clinical professionals. Its main resources are based on the evidence matrix of Epistemonikos and analysis of results using GRADE methodology. Further details of the methods for developing this FRISBEE are described here (<http://dx.doi.org/10.5867/medwave.2014.06.5997>)

Epistemonikos foundation is a non-for-profit organization aiming to bring information closer to health decision-makers with technology. Its main development is Epistemonikos database

www.epistemonikos.org.

11. Ferreira JM, Pinheiro SL, Sampaio FC, de Menezes VA. Caries removal in primary teeth—a systematic review. *Quintessence Int.* 2012 Jan;43(1):e9-15. | PubMed |
12. Pedrotti D, Cavalheiro CP, Casagrande L, de Araújo FB, Petrossi Imparato JC, de Oliveira Rocha R, et al. Does selective carious tissue removal of soft dentin increase the restorative failure risk in primary teeth?: Systematic review and meta-analysis. *J Am Dent Assoc.* 2019 Jul;150(7):582-590.e1. | CrossRef | PubMed |
13. Foley J, Evans D, Blackwell A. Partial caries removal and cario-static materials in carious primary molar teeth: a randomised controlled clinical trial. *Br Dent J.* 2004 Dec 11;197(11):697-701; discussion 689. | PubMed |
14. Franzon R, Guimarães LF, Magalhães CE, Haas AN, Araujo FB. Outcomes of one-step incomplete and complete excavation in primary teeth: a 24-month randomized controlled trial. *Caries Res.* 2014;48(5):376-83. | CrossRef | PubMed |
15. Lula EC, Monteiro-Neto V, Alves CM, Ribeiro CC. Microbiological analysis after complete or partial removal of carious dentin in primary teeth: a randomized clinical trial. *Caries Res.* 2009;43(5):354-8. | CrossRef | PubMed |
16. Orhan AI, Oz FT, Ozcelik B, Orhan K. A clinical and microbiological comparative study of deep carious lesion treatment in deciduous and young permanent molars. *Clin Oral Investig.* 2008 Dec;12(4):369-78. | CrossRef | PubMed |
17. Orhan AI, Oz FT, Orhan K. Pulp exposure occurrence and outcomes after 1- or 2-visit indirect pulp therapy vs complete caries removal in primary and permanent molars. *Pediatr Dent.* 2010 Jul-Aug;32(4):347-55. | PubMed |
18. Phonghanyudh A, Phantumvanit P, Songpaisan Y, Petersen PE. Clinical evaluation of three caries removal approaches in primary teeth: a randomised controlled trial. *Community Dent Health.* 2012 Jun;29(2):173-8. | PubMed |
19. Rando-Meirelles MPM, Tôres LHN, Sousa MLR. Twenty-Four Months Of Follow-Up After Partial Removal Of Carious Dentin: A Preliminary Study. *Dentistry.* 2013; (3):162. | CrossRef |
20. Ribeiro CC, Baratieri LN, Perdigão J, Baratieri NM, Ritter AV. A clinical, radiographic, and scanning electron microscopic evaluation of adhesive restorations on carious dentin in primary teeth. *Quintessence Int.* 1999 Sep;30(9):591-9. | PubMed |
21. Franzon R, Opdam NJ, Guimarães LF, Demarco FF, Casagrande L, Haas AN, et al. Randomized controlled clinical trial of the 24-months survival of composite resin restorations after one-step incomplete and complete excavation on primary teeth. *J Dent.* 2015 Oct;43(10):1235-41. | CrossRef | PubMed |
22. Schwendicke F, Mostajaboldave R, Otto I, Dörfer CE, Burkert S. Patients' preferences for selective versus complete excavation: A mixed-methods study. *J Dent.* 2016 Mar;46:47-53. | CrossRef | PubMed |
23. American Academy of Pediatric Dentistry (AAPD). Guideline on Restorative Dentistry. Reference Manual. 2015; 37(6): 232-43.
24. ClinicalTrials.gov [Internet]. Bethesda (MD): National Library of Medicine (US). Identifier 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). (DECAT); 2014 Nov 7. [On line]. | Link |

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