Living FRIendly Summaries of the Body of Evidence using Epistemonikos (FRISBEE)

Chemo-mechanical removal versus conventional removal for deep caries lesion

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Key words Chemomechanical caries removal, caries removal, dental caries, minimally invasive dentistry, Epistemonikos, GRADE.

Abstract

Introduction

Dental caries have been traditionally managed with the non-selective removal of carious tissue (total removal). However, the adverse effects and fear that this technique produces in patients has promoted the use of more conservative caries removal techniques such as chemo-mechanical removal, but there is still controversy regarding its effectiveness and safety.

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 34 studies overall, of which 30 correspond to randomized trials. We concluded that chemo-mechanical caries removal probably reduces the need for anesthesia. Additionally, chemo-mechanical caries removal may decrease the pain experienced by the patient, decrease the risk of restoration failure and increase the time of the procedure for the removal of deep caries, but the certainty of the evidence is low. We are uncertain whether chemo-mechanical caries removal reduces the risk of pulp exposure as the certainty of the evidence has been assessed as very low.

Problem

Dental caries, the most prevalent oral condition worldwide [1], produces localized destruction of dental tissue [2]. The treatment of carious lesions consists of their removal and subsequent restorative treatment.

Currently there are several techniques for tooth decay removal. Conventional treatment involves the total (non-selective) removal of the caries with rotary and manual instruments. In recent years, the total removal technique has been criticized for increasing the risk of pulp exposure and pulp diseases [3], [4]. In addition, the conventional total removal technique causes anxiety and fear in patients.

Consequently, new alternatives for caries removal have emerged such as chemo-mechanical removal [5], which allows the removal of carious tissue through the application of a substance that softens the affected tissue in combination with manual instrumentation [6]. The most reported products in the literature to carry out this technique are Carisolv (swedish origin) and Papacarie (brazil origin). Its mechanism of action is comparable and is based on the breakdown of partially degraded collagen molecules, which contributes to the degradation and elimination of the fibrin mantle formed by the carious process [7], [8]. However, it has been suggested that this technique would lead to restoration failure, so its use remains controversial [9]. This summary aims to evaluate the effectiveness and safety of chemo-mechanical removal compared to conventional total caries removal.

Key messages

- Chemo-mechanical caries removal compared to conventional total removal probably reduces the need for anesthesia.
- Chemo-mechanical caries removal compared to conventional total removal may slightly decrease the pain experienced by the patient during the procedure, decrease the risk of failure of restorations and increase the duration of the procedure (low certainty of evidence).
- We are uncertain whether chemo-mechanical caries removal reduces the risk of pulp exposure as the certainty of the evidence has been assessed as very low.

About the body of evidence for this question

What is the evidence. See evidence matrix in Epistemonikos later	We identified seven systematic reviews [9], [10], [11], [12], [13], [14], [15] including 34 primary studies reported in 35 references [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], of which 30 were randomized trials [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [27], [28], [30], [31], [32], [33], [35], [36], [37], [38], [39], [40], [41], [42], [43], [45], [46], [47], [48, [49]. The table and summary are based on the randomized trials, as the observational studies did not increase the level of certainty of the evidence, nor added any additional relevant information.
What types of patients were included*	Of the 30 trials, 20 included only children (two to 12 years) [18], [19], [20], [21], [22], [23], [24], [27], [30], [31], [33], [35], [36], [37], [38], [40], [43], [46], [47], [49], four trials included children and adults (2.5 to 85 years) [16], [25], [28], [41], four trials included children, adolescents and adults (six to 68 years) [17], [39], [42], [48] and two trials did not report the age of the participants [32], [45]. Nineteen trials included only primary teeth [18], [19], [20], [21], [22], [23], [24], [27], [30], [31], [33], [36], [37], [38], [43], [45], [46], [47], [49], four trials included only permanent teeth [17], [39], [42], [48], four trials both dentitions [16], [25], [28], [41] and three trials did not report the type of dentition [32], [35], [40]. Finally, regarding the extent of the caries, all included only dentin caries, excluding those lesions limited only to enamel. [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [27],

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 reanalyzed 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.

	[28], [30], [31], [32], [33], [35], [36], [37], [38], [39], [40], [41], [42], [43], [45], [46], [47], [48].
What types of interventions were included*	All trials compared chemo-mechanical removal against conventional treatment (total removal). Chemo-mechanical removal was described differently by the trials, but in general it was defined as the removal of cavities using chemicals that degrade carious tissue (Carisolv, Caridex, Carie-care or Papacarie) followed by the removal of the softened tissue with mechanical removal (spoon excavator) [9]. Fourteen trials used Carisolv [16], [17], [21], [24], [25], [27], [28], [30], [31], [41], [43], [45], [47], [48]. Seven trials used Papacarie [19], [20], [22], [23], [33], [40], [49]. Three studies compared Carisolv and Papacarie [18], [35], [46]. Four studies [36], [37], [38], [39] report using the Carie-care material. A single trial [32] used Caridex and only one trial [42] did not report what type of material was used. Total removal was described as excavation until pulpo-proximal dentine on the cavity floor was hard on probing [9].
What types of outcomes were measured	The trials evaluated multiple outcomes, which were grouped by the systematic reviews as follows: • Pulp exposure • Pain during the cavity removal procedure measured as a dichotomous and continuous outcome using the Wong Baker Faces Pain Scale (WBF), Visual Analog Scale (VAS), Verbal Pain Scale (VPS) and Face, Leg, Activity, Cry, Consolability (FLACC) scale. • Failure of restoration • Need for anesthesia • Treatment time These trials reported [22,33,24,25,33,47] follow-up that ranged from 1 to 18 months; the other studies did not report the follow-up time.

* 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 chemo-mechanical caries removal is based on 30 randomized trials that included 1,351 patients [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [27], [28], [30], [31], [32], [33], [35], [36], [37], [38], [39], [40], [41], [42], [43], [45], [46], [47], [48].

Only one trial measured pulp exposure events (40 patients, 80 teeth) [30], 10 trials measured pain (553 patients and 839 teeth) [16], [20], [22], [24], [25], [28], [31], [38], [47], [48], six trials evaluated restoration failure events (261 patients, 432 teeth) [21], [22], [24], [25], [31], [47], 14 trials measured the need for anesthesia (703 patients and 1169 teeth) [16], [17], [21], [23], [24], [25], [28], [30], [31], [32], [33], [39], [47], [48] and 24 trials measured time spent on carious tissue removal (1163 patients and 2069 teeth) [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [27], [28], [30], [31], [32], [33], [35], [36], [37], [38], [39], [46], [47], [48].

The summary of findings is the following:

- We are uncertain whether chemo-mechanical caries removal reduces the risk of pulp exposure as the certainty of the evidence has been assessed as very low

- Chemo-mechanical caries removal compared to total removal may decrease the risk of pain during caries removal procedure (low certainty of evidence).
- Chemo-mechanical caries removal compared to conventional total removal may decrease the risk of failure of restorations (low certainty of evidence).
- Chemo-mechanical caries removal compared to conventional total removal probably reduces the need for anesthesia (moderate certainty evidence).
- Chemo-mechanical caries removal compared to conventional total removal could increase the time of the procedure (low certainty of the evidence).

Chemo-mechanical removal versus conventional removal for deep dental caries

Patients Patients with deep dental caries
Intervention Chemo-mechanical removal
Comparison Conventional total removal (non-selective)

Outcome	Absolute effect*		Relative effect (95% CI)	Certainty of evidence (GRADE)
	WITH total removal	**WITH chemo-mechanical removal**		
	Difference: patients per 1000			
Pulp exposure	25 per 1000	8 per 1000	RR 0.33 (0.01 a 7.95)	⨁◯◯◯[1,2,3] Very low
	Difference: 17 less (Margin of error: 25 less to 174 more)			
Pain**	441 per 1000	203 per 1000	RR 0.46 (0.34 a 0.61)	⨁⨁◯◯[1,4] Low
	Difference: 238 less (Margin of error: 291 to 172 less)			
Failure of restoration	68 per 1000	37 per 1000	RR 0.55 (0.25 a 1.2)	⨁⨁◯◯[1,2] Low
	Difference: 31 less (Margin of error: 51 less to 15 more)			
Need for anesthesia	329 per 1000	59 per 1000	RR 0.18 (0.10 a 0.32)	⨁⨁⨁◯[1] Moderate
	Difference: 270 less (Margin of error: 296 to 224 less)			
Time spent on carious tissue removal (minutes)	3.37 minutes	6.68 minutes	--	⨁⨁◯◯[1,2,5] Low
	DM: 3.31 more (Margin of error: 0.79 a 5.83 more)			

Margin of error: 95% confidence interval (CI).
RR: Risk ratio.
MD: Mean difference.
GRADE: Evidence grades of the GRADE Working Group (see later).

*The risk **WITH Conventional total removal** is based on the risk in the control group of the trials. The risk **WITH Chemo-mechanical removal** (and its margin of error) is calculated from relative effect (and its margin of error).
** Measured as the presence or not of pain during the caries removal procedure.

[1] The certainty of evidence was downgraded in one level for risk of bias since in most of the included trials the generation of randomization sequence and its concealment is not clear. Furthermore, several trials were not blinded.
[2] The certainty of evidence was downgraded in one level due to imprecision, since each end of the confidence interval leads to a different decision.
[3] The certainty of evidence was downgraded in one level due to indirectness of evidence, as it corresponds to a surrogate outcome.
[4] The certainty of evidence was downgraded in one level due to publication bias, according to what was observed in the funnel plot and the result of the Egger test (0.0026).
[5] The certainty of evidence was downgraded in one level for inconsistency, since the different included trials present 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 conclusiones of this summary can be applied to both child and adult patients with deep dental caries in deciduous and/ or permanent dentition, especially children, persons with special health care needs, patients with behavioral problems or in whom local anesthesia is contraindicated.

The results of this summary are not applicable to patients with non-cavitated caries or with pulp exposure.

About the outcomes included in this summary

Most of the outcomes included in the summary of findings table are those considered critical for decision-making, according to the authors' opinion, and in general, coincide with the systematic reviews identified.

The outcome pulp exposure was included in the results summary table because it is a relevant outcome for clinical experts, even when it is a surrogate outcome of the need for endodontic treatment.

The outcome need for endodontic treatment is critical for health decision-making as it involves performing an additional procedure that is more complex and expensive for the patient, but this was not reported in the systematic reviews analyzed. Instead, the outcome pulp exposure was included as a surrogate outcome of the need for endodontic treatment, that is also relevant for clinical experts.

Pain was reported in the summary of findings table as a dichotomous outcome, as most trials (10 trials) [16], [20], [22], [24], [25], [28], [31], [38], [47], [48] presented it in this way and the direction of the effect did not differ from those that evaluated it continuously (seven trials) [18], [19], [27], [37], [39], [40], [46].

It is necessary to establish main outcomes (core set outcomes) for primary studies on caries management that incorporate measures of long-term effectiveness (restoration survival), in addition to the values and preferences of the patients.

Balance between benefits and risks, and certainty of the evidence

The evidence shows a probable benefit in reducing the need for anesthesia, showing advantages of chemo-mechanical removal over non-selective removal. Furthermore, it could show a benefit in reducing the pain during the procedure and restoration failure. However, there is uncertainty since the certainty of the evidence is low.

Also, there is uncertainty about the possible risk of chemo-mechanical in relation to the occurrence of pulp exposure as the certainty of the evidence has been assessed as very low.

On the other hand, chemo-mechanical removal could increase the time of the procedure, which could correspond to a disadvantage of the procedure.

In consideration of the above, the benefit/harm balance could be in favor of chemo-mechanical removal. However, due to the certainty of the evidence, it is important that decision-making is carried out individually, taking into account additional factors associated with the experience and preferences of both patients and treating physicians regarding the caries removal technique.

Resource considerations

None of the identified systematic reviews performed a cost difference analysis between chemo-mechanical and conventional technique of carious removal. However, the cost of dental materials necessary to perform chemo-mechanical removal is not high.

What would patients and their doctors think about this intervention

Most patients prefer chemo-mechanical removal over non-selective removal, because this technique reduces the need for anesthesia and pain during the procedure. This would improve the anxiety produced by dental treatment, especially in children. However, the patient's personality and previous dental experiences are important factors for decision-making [50].

There is evidence that almost half of dentists prefer the use of conventional techniques such as total removal in the management of deep dental caries. However, in recent years this preference tends to decrease, increasing the preference for conservative removal techniques [50].

Differences between this summary and other sources

The conclusions of this summary are consistent with the seven identified systematic reviews [9], [10], [11], [12], [13], [14], [15] which consider that chemo-mechanical removal decreases pain, the need for anesthesia and increases the time of the procedure. Also, declare that there is uncertainty about the outcomes of pulp restoration failure and exposure, as reported in this evidence summary.

Could this evidence change in the future?

The probability that future research will change the conclusions of this summary is high due to the uncertainty in the existing evidence on the outcomes of pulp exposure, pain, failure of restorations and the time of the procedure to perform tooth decay removal.

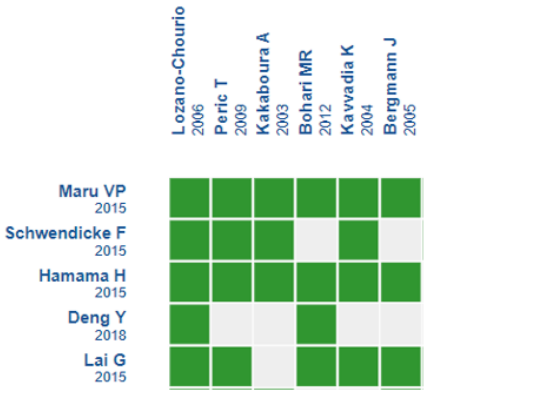
Is unlikely that future research will change the conclusions about the need for anesthesia, because the certainty of the evidence is moderate.

We identified two ongoing randomized trials in ClinicalTrials.gov that could yield relevant data for pain and restoration failure [51], [52].

We did not identify any systematic review in progress 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.



An evidence matrix is a table that compares systematic reviews that answer the same question.
Rows represent systematic reviews, and columns show primary studies.
The boxes in green correspond to studies included in the respective revisions.
The system automatically detects new systematic reviews including any of the primary studies in the matrix, which will be added if they actually answer the same question.

Follow the link to access the **interactive version** Chemo-mechanical removal versus conventional removal for deep dental caries.

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.

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