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Deep margin elevation vs alternative restorative approaches for posterior teeth with subgingival margins: a systematic review of clinical trials

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Systematic Review

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Deep margin elevation vs alternative restorative approaches for posterior teeth with subgingival margins: a systematic review of clinical trials

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Abstract

Background: Deep margin elevation (DME) combined with indirect, adhesively retained partial-coverage restorations is often advocated for posterior teeth with subgingival or sub-cemento-enamel junction (CEJ) margins, but the clinical evidence base is uncertain. This systematic review aimed to identify prospective randomised controlled trials comparing DME with indirect adhesively retained partial-coverage restorations against alternatives for managing such teeth.

Methods: Five databases (PubMed, Medline, Embase, Scopus, OpenGrey via DANS) were searched for prospective randomised controlled trials. Two reviewers independently screened studies, extracted data, and assessed risk of bias using Cochrane RoB-2. Certainty of evidence was evaluated using GRADE.

Results: Two randomised controlled trials met the inclusion criteria, with different comparators (direct luting to dentine; surgical crown lengthening) and eligibility criteria (vital versus endodontically treated teeth). Owing to substantial heterogeneity, formal data synthesis was not undertaken. Both studies followed patients for 12-months, primarily assessing periodontal parameters, with no reported restoration or tooth failures. Both were judged at moderate risk of bias, and certainty of evidence for all outcomes was very low.

Conclusions: There is a paucity of high-quality randomised controlled trial data comparing DME with indirect adhesively retained partial-coverage restorations to alternatives for teeth with deep subgingival margins. Clinicians cannot currently be given confident, evidence-based guidance on the optimal restorative approach for posterior teeth with deep subgingival margins; decisions must rely on clinical judgement, patient factors, and further high-quality research.

Keywords
Cervical margin relocation, Composite resins, Dental bonding, Dental caries, Dental restoration, Proximal box elevation

Background

Clinicians use a range of approaches to manage complex cavities extending subgingivally or below the cemento-enamel junction (CEJ). Treatment choice may be influenced by the evidence base, training, experience, technical skills, available materials, healthcare and remuneration systems, and patients' risk profiles, preferences and ability to pay, as examples (1-3).

Where possible, adhesive approaches are increasingly favoured in accordance with minimal-intervention principles (4-7). These aim to preserve peri-cervical tooth tissue and facilitate future restoration following failure, potentially prolonging tooth survival (7-9). However, deep subgingival adhesive restorations present two major challenges: preventing contamination during bonding and achieving a durable bond to marginal dentine (2). These factors may contribute to caries associated with restorations (secondary caries) or loss of retention over time (9, 10).

Recent literature has focused on adhesively retained, partial-coverage indirect restorations combined with deep margin elevation (DME) for managing localised subgingival margins (11-19). DME involves placing restorative material, most commonly resin-based composite (composite), at a deep cavity margin before restoring the supragingival anatomical form, commonly including the proximal contact (11). First described as cervical margin relocation in 1998 and termed DME in 2012, the technique was initially associated with indirect restorations but has since been applied to direct restorations, without clear consensus on its definition (11, 20, 21).

DME aims to simplify subsequent restorative procedures by relocating the margin supragingivally. This facilitates impression taking, isolation, adhesive bonding and removal of excess resin cement (11). Isolation is particularly important because retention commonly depends on the effective resin cement bond rather than preparation geometry and a matrix band cannot commonly be applied to facilitate this as it would prevent seating of the restoration. DME does however create two restorative interfaces with the tooth, which is potentially a compromise conflicting with the traditional principle that indirect restoration margins should be placed on sound tooth tissue (22, 23).

Indirect adhesive restorations combined with DME have been presented as the preferred treatment for these cavities, with direct composite considered suboptimal and crowns unnecessarily invasive (24-27). However, the supporting clinical evidence remains uncertain. Treatment planning is further complicated by differing approaches to periodontal management, ranging from no intervention or gingivectomy to surgical crown lengthening, surgical extrusion or orthodontic extrusion (24, 28, 29).

Although several recent reviews have examined DME techniques, they have often emphasised laboratory studies of uncertain clinical relevance or focused on the materials used or periodontal response (12, 13, 16). Few have focused on restoration or tooth survival of the various clinical approaches for managing deep subgingival margins.

This systematic review therefore aimed to identify prospective randomised controlled clinical studies comparing DME combined with adhesively retained, partial-coverage indirect restorations against alternative approaches for posterior teeth with subgingival or sub-CEJ cavity margins, to inform clinical decision-making.

Methods

Research Question

The study was registered in the International Prospective Register of Systematic Reviews (PROSPERO CRD420251233458).

A research question was developed using a PICO (Population, Intervention, Comparator, Outcomes) framework to guide eligibility criteria. The review addressed the question: In posterior teeth with subgingival or sub-CEJ margins (population), how does DME with indirect adhesively retained partial-coverage restorations (resin-based composite or glass ceramic) (intervention) influence restoration and tooth survival (primary outcomes), periodontal indices and complications (secondary outcomes) compared with alternatives (comparators)? The systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

Eligibility Criteria

Studies with full reports were selected according to the following inclusion criteria:

- Studies directly related to the research question
- Prospective randomised controlled trials
- Human studies
- English language articles

Search Strategy

A comprehensive search was undertaken on 1 December 2025 to identify published and unpublished reports of studies relating to the research question. Five databases, Pubmed, Medline, Embase, Scopus and OpenGrey through DANS were searched using predefined concepts, adapted to the controlled vocabulary and syntax of each database. Details of the search concepts are provided in Online Resources Table 1.

Selection Process

Following removal of duplicates, studies were selected through a three-stage screening process carried out independently by two investigators (OB and DL).

Phase 1: Titles and abstracts of the articles were independently screened against the eligibility criteria.

Phase 2: Full texts of relevant articles were assessed against the same eligibility criteria.

Phase 3: Backward and forward citation searching of the reference lists of included articles was performed.

Results of each phase were compared for consistency, and any disagreements were resolved through discussion. Reasons for exclusion were documented.

Data Collection

Two investigators (OB and DL) independently extracted data from the included studies. Structured, pilot-tested data extraction spreadsheets were used to record study design, comparators (restoration type), number of participants, follow-up period, number of dropouts, and outcomes.

Risk-of-Bias Assessment

Two reviewers (OB and DL) independently assessed the risk of bias of each included study, using the Cochrane Risk of Bias 2 (RoB-2) tool. Studies were evaluated across predefined domains, with overall judgements derived from responses to signalling questions. Disagreements were resolved through discussion among the reviewers.

Certainty of Evidence

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) system was used to assess the certainty of evidence against the primary outcomes of the systematic review.

Results

Included Studies

Figure 1 illustrates the results of the selection process for the systematic review. Two studies met the inclusion criteria for this review (30, 31).

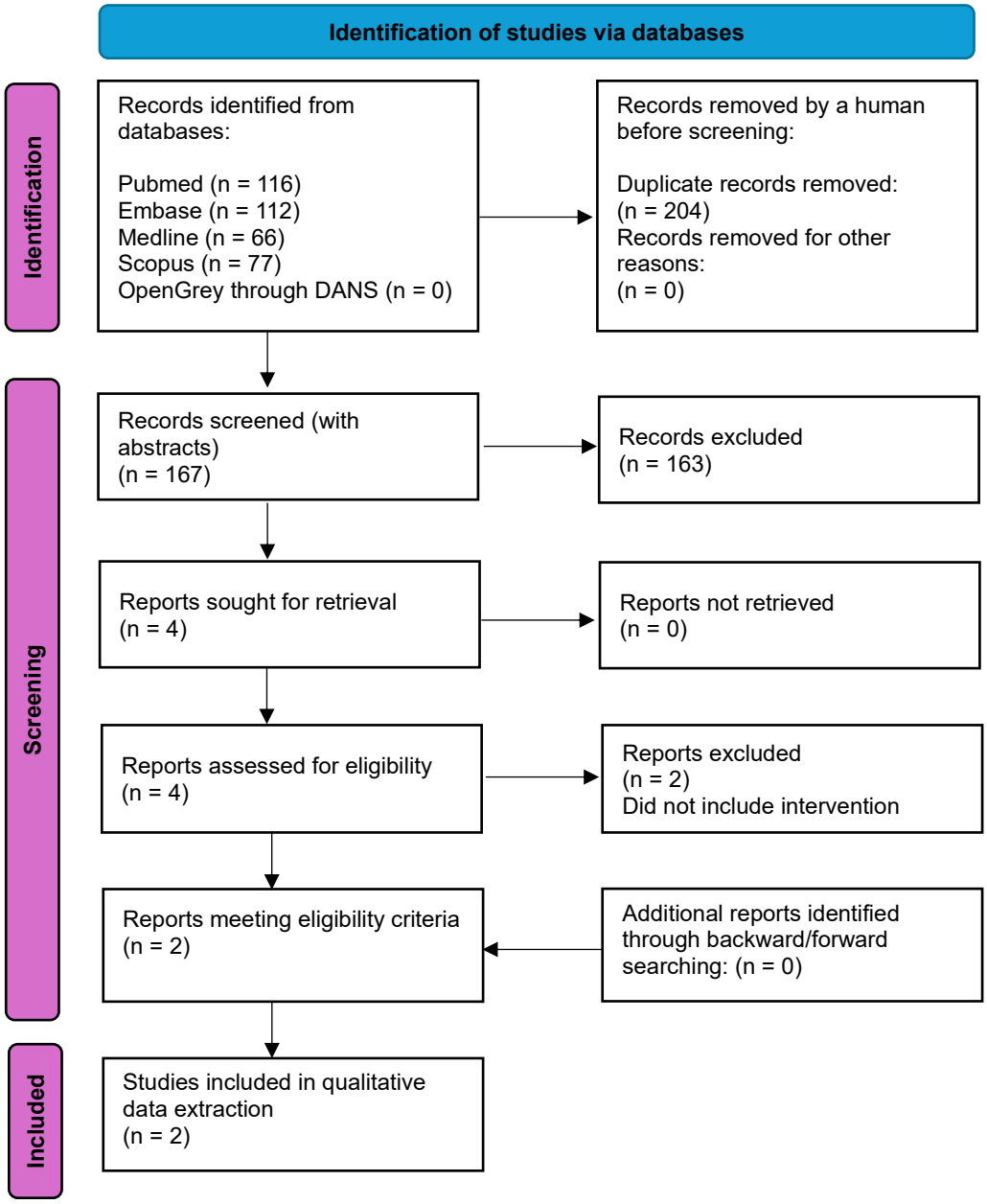


Fig 1 PRISMA flow diagram showing study inclusion process

Characteristics of Included Studies

Study Design

Both included studies were prospective randomised controlled trials involving cohorts of adult patients treated with restorative procedures incorporating DME (30, 31). Both followed patients for 12-months with the aim of assessing periodontal parameters as their primary outcome measures. The comparator interventions were different in each study, with differing inclusion criteria (non-vital molars versus vital premolars and molars). Salient details of the studies are shown in Table 1.

Table 1. Details of included studies

Study	Study design	Comparators	Number in each group	Exclusion criteria	Follow-up	Drop-outs	Outcomes
Ferrari et al. 2018	RCT	Lithium disilicate onlay luted: • following deep margin elevation (DME) • directly to dentine (shoulder preparation) *On same tooth Vital premolar / molars with sub-cemento-enamel junction margins	35 patients; 35 restorations	• <18-years • Pregnancy • Disabilities • Potential prosthodontic restoration of the tooth (use as abutment) • Pulpitic/non-vital/endodontically treated teeth • Profound periodontitis • Deep defects (<1mm to pulp preoperatively) or pulp capping • Bruxism/heavy occlusal contacts • Systemic disease or severe medical complications • Methacrylate allergy • Rampant caries • Xerostomia • Lack of compliance • Language barriers • Plaque index >20% • Residual dentine thickness <0.5mm following cavity preparation	12 months	None	• Gingival index (GI): Both groups showed increases in GI but no statistically significant differences between groups • Plaque index (PI): Both groups showed increases in PI but no statistically significant differences between groups • Periodontal probing depths (PPDs): Both groups showed increases in PPDs but no significant differences between groups • Bleeding on probing (BoP): Both groups showed increases in BoP with a significantly higher increase in the DME group (BoP positive 31.5% no DME vs 51% DME) • Crestal bone level: All cases with BoP showed margin-crest measurements between 2-3mm • Secondary caries: No secondary caries in either group
Farouk et al. 2023	RCT	Indirect composite overlay luted following: • DME • surgical crown lengthening (SCL) Endodontically treated molars	20 patients; 20 restorations	• <18-years • Medically compromised • Periodontitis • Poor oral hygiene • Thin gingival biotype • Failing endodontics • <50% remaining sound tooth structure • <1-2mm between gingival seat (margin) and crestal bone	1,3,6,9, 12 months	1 (SCL group)	• Clinical Attachment Level (CAL): No difference between groups at 0-1 months. SCL group higher mean CAL all other times • BoP: Significant reduction in BOP over time but no significant difference between groups • PPDs: No significant differences between groups at 1,3 and 6 months. SCL group significantly higher than DME at 9 and 12 months (2.61mm [standard deviation (SD)=0.56] vs 2.1mm [SD=0.39]) • Crestal bone level: DME showed lower reduction in crestal bone levels than SCL at all times (due to osseous recontouring). Both groups showed significantly higher mean bone level measurements (indicating bone loss) at 12 months • Secondary caries: No secondary caries in either group

RCT, randomised controlled trial.

Ferrari et al. monitored sub-CEJ junction interproximal restoration margins following the placement of lithium disilicate onlays in vital molar and premolar teeth. Outcomes from restorations placed on DME margins and those luted directly onto dentine using a shoulder preparation were compared. Each restoration included both margin types, allowing direct intra-tooth comparison, but prevented appraisal of differences in restoration or tooth survival between the groups.

Farouk et al. studied patients with indirect composite overlays placed on endodontically treated molar teeth with subgingival restoration margins. The cohort was divided into two groups: those undergoing DME versus surgical crown lengthening (SCL) prior to overlay placement. The location of the margins was described as deep, but otherwise not specified (other than excluding margins '<1-2mm between gingival seat (margin) and crest of bone'.

Randomisation and Blinding
In the study by Ferrari et al. group allocation was randomised using a coin-toss method, while Farouk et al. used a random sequence generator.

Owing to the differing nature of the procedures in both studies, blinding of the patients or operators was not feasible. However, Farouk et al. reported blinding during postoperative assessment, with the assessor and statistician blinded to treatment allocation.

Patient Selection
Ferrari et al. placed 35 restorations in a consecutive sample of 35 adult patients (mean age 45-years), recruited from a hospital prosthodontic department. All patients were periodontally healthy, and pulp vitality of the sample teeth was confirmed using thermal testing. Extensive exclusion criteria were applied as shown in Table 1 including deep carious defects, bruxism, and poor oral hygiene.

Farouk et al. studied a sample of 20 adult molars with successful endodontic treatment. Similar exclusion criteria were applied, with the additional exclusion of patients with a thin periodontal biotype (see Table 1). Farouk et al. also specified that included teeth were required to have more than 50% sound tooth structure existing, with a gingival seat located at least 1-2mm from the crestal bone level.

DME Protocol
Similar DME protocols were described across the studies. The procedures involved caries removal and preparation of the interproximal box under rubber dam isolation, followed by adaptation of wedged circumferential matrices.

The studies employed universal bonding agents apparently using self-etching of the dentine and incremental placement of light-cured composite to achieve supragingival elevation of the restorative margins. However Ferrari et al. used a conventional flowable composite whereas Farouk et al. used both flowable and paste bulk-fill composites.

Restoration Survival and Tooth Survival
Though not explicitly stated, all assessed restorations appeared to remain intact at the one-year follow-up in both studies, with no reported complications requiring re-intervention.

Periodontal Outcomes

Ferrari et al. reassessed periodontal parameters at 12-months to evaluate changes in periodontal health, assessed using multiple indices. Measurements of Plaque Index (PI) and Gingival Index (GI) showed slight increases from baseline, but no significant differences between margin types. Periodontal probing depths (PPDs) increased in both groups; however, no significant intergroup differences were observed. A significant difference in bleeding on probing (BOP) between margin types was noted however.

Farouk et al. found no significant differences in clinical attachment loss (CAL) between groups at baseline or at 1-month follow-up. However, statistically significant differences were detected at 3, 6, 9 and 12 months, with the SCL group showing higher mean CAL than the DME group. Both groups demonstrated statistically significant reductions in BOP over time, with no significant differences observed between the groups, indicating a favourable periodontal response. With respect to PPDs, no significant intergroup differences were detected at 1,3 or 6 months. However, at 9 and 12 months, the SCL group exhibited significantly higher mean PPDs than the DME group, though the difference was 0.5mm.

Risk of Bias

Both included studies were judged to have a moderate risk of bias as shown in Table 2, due to unclear allocation concealment (30), lack of blinding of operators and participants (30), unexplained missing outcome data (31) and the absence of pre-specified analysis plans (30, 31).

Table 2. Cochrane RoB-2 Summary

RoB-2 Domain	Ferrari et al. 2018	Farouk et al. 2024
Randomisation process		
Deviations from the intended interventions		
Missing outcome data		
Measurement of outcome		
Selection of the reported result		
OVERALL RISK OF BIAS		

 Low risk of bias  Some concerns  High risk of bias

Certainty of Evidence
Though the included studies were both randomised controlled trials, the certainty of evidence using GRADE was rated as very low, being downgraded due to risk of bias, indirectness and imprecision (Online Resources Table 2).

Discussion

This systematic review identified two RCTs comparing DME followed by adhesively retained, partial-coverage indirect restorations with alternative approaches for managing deep cavity margins (30, 31). Both primarily assessed periodontal outcomes but used different eligibility criteria: one included vital teeth and the other endodontically treated teeth. Comparators also differed, comprising surgical crown lengthening (SCL) in one study and direct luting of an indirect restoration to a deep subgingival margin in the other.

In Ferrari et al., both interventions were applied to different margins of the same restoration, precluding comparison of restoration or tooth survival. However, secondary caries was assessed and could have demonstrated a difference. At 12-months, all restorations survived without clinical or radiographic evidence of caries. The other included study similarly identified no short-term differences between interventions in its primary outcomes.

Periodontal, gingival and plaque indices generally worsened from baseline in the Ferrari study. This may reflect baseline measurements being recorded one week after oral hygiene instruction and prophylaxis by a periodontist (30). Conversely, these indices improved following restoration in the Farouk study, in which no pre-operative preventive phase was reported (31). These methodological differences make the effect of the interventions difficult to determine, while the statistically significant differences observed may have limited clinical relevance.

No studies directly comparing indirect and direct restorations were identified. Indirect restorations are more expensive than direct restorations in most healthcare systems, although direct composite restorations are often considered inappropriate for extensive cavities by experts and textbooks (3).

Recent evidence showed that the subgingival extent of a cavity influenced many experts' willingness to place direct composite, though it did not influence others (3). Clinicians who used a broader range of techniques, including those not commonly presented in textbooks, were more willing to restore complex cavities with deep subgingival margins using direct composite (3). Additionally, although a deep subgingival margin influenced treatment decisions, it was less important than a large bridging gap, broad box, root-filled tooth or involvement of three or more surfaces (3).

Large, complex direct composite restorations with subgingival margins have demonstrated good longer-term outcomes in a limited number of studies with varied designs (32-34). However, operators were commonly experts who used multiple techniques, such as papillectomy and circumferential matrices with increased curvature combined with sectional matrices, to overcome the challenges associated with deep margins (2).

One RCT compared gingivectomy using a Thermacut bur, which preferentially removes soft tissue without damaging teeth, with conventional SCL for managing deep subgingival caries located 1–2

mm from the crestal bone in vital teeth restored with direct composite (35). The gingivectomy group included 15 participants, with two lost to follow-up, while the SCL group included 15, with one lost. No restorations failed within 12 months.

Post-operative pain was significantly greater following SCL, although no differences were present at six or 12-months. Bleeding on probing reduced in both groups, with no significant between-group difference. Three gingivectomy cases and two SCL cases exhibited bleeding on probing. Probing pocket depths increased from the immediate post-operative values following gingivectomy, as expected after papilla removal, but the pre-operative and 12-month means and standard deviations were identical. SCL produced no change in probing depths but, unsurprisingly, reduced crestal bone levels. No differences in marginal staining, integrity or surface roughness were found at 12-months.

The authors noted, without presenting supporting data, that black triangles (incomplete papilla infill) occurred after SCL but not gingivectomy. Gingivectomy or papillectomy removes obstructing soft tissue which can facilitate isolation and effective wedge placement without deforming the matrix or compromising the restoration emergence profile (28). It may also encourage papillary refill by permitting a more cervical contact while preserving alveolar bone and minimising the distance between the contact and alveolar crest. This may explain the RCT findings, as papillary fill is predictable when this distance is ≤5 mm (36). Conversely therefore, bone removal may increase the risk of incomplete papillary fill and black triangles. Eliminating dead space below the contact may also reduce food packing, although the evidence supporting its relationship with disease remains weak (37).

DME combined with direct or indirect restorations can provide favourable clinical outcomes for extensive cavities in selected studies, although important complexity factors have often been incompletely reported (3, 38-41). The deepest portion of the restoration, which may be most critical to failure, is generally similar with either approach. Indirect restorations are commonly more rigid but less resilient than direct composites with differences within these groups, and the clinical importance of these properties and techniques remains uncertain (42-44). Composite may require more maintenance and degrade more than ceramic, but is more readily repaired. The importance of these differences to patients and clinicians is again uncertain.

Crown materials have also evolved, allowing tooth-coloured restorations to be provided with minimal preparation (45). Defined knife-edge margins and undefined vertical margins used in biologically orientated preparation techniques are distinct approaches with potentially different biological advantages and costs (45). In extensively broken-down teeth, however, the additional sacrifice of tooth tissue may be minimal, particularly in the peri-cervical region considered important to prognosis, and these approaches have been advocated in recent guidance (45).

Clinical guidance recommending one approach over another for compromised teeth remains difficult to justify. For direct composites, patient risk and operator-related factors appear to be the strongest determinants of restoration survival (46). Technique may be important in severely compromised teeth, but the available clinical evidence is insufficient to establish this. Dogmatic claims regarding techniques considered essential for success, including the need for indirect restorations, are often based on expert opinion and laboratory studies of uncertain clinical relevance rather than robust clinical evidence (3, 25).

This systematic review highlights the paucity of high-quality clinical evidence to support decisions for complex cavities with deep subgingival margins. The burden of proof should therefore rest with those proposing more expensive, time-consuming or invasive procedures. Based on this, it should not be deemed inappropriate to take a pragmatic, graded approach initially, restoring as simply as possible using, for example, direct restorations and papillectomy before reassessment and further intervention where required (3, 28, 47, 48).

Periodontal responses are variable, and bone removal can be undertaken later if necessary (28). SCL carries potential costs, including loss of periodontal support; exposure of root surfaces or furcations on the treated and adjacent teeth; increased caries and periodontal risk; compromise of future implant sites; and an increased crown-to-root ratio with less favourable loading. These are additional to the financial, time and surgical costs (28). Patient preferences, including willingness and ability to pay, should also inform decisions because valuations of restoration characteristics vary (1). Clinicians' skills and experience, alongside remuneration, treatment costs and healthcare systems, as examples, will also influence management (2, 3).

Despite the available evidence, restoring deep subgingival margins with composite remains a concern in primary care, principally because of difficulties with isolation and limited clinician confidence (49, 50). This may be increasingly important following the EU phase-out of amalgam and its phase-down elsewhere, as amalgam was often used for extensive cavities where moisture control was difficult (2, 51). Many UK primary care clinicians report substantially greater confidence using amalgam than composite in subgingival cavities (49). Evidence indicates that resin-based composite restorations extending below the CEJ fail more frequently than those with supragingival margins, although deeper margins were not significantly associated with caries-related failure (41). This may mitigate some concerns, but restoring compromised teeth inevitably carries greater risk for patients and clinicians and warrants further investigation.

The higher cost of indirect restorations may also lead to extraction where clinicians are unwilling to offer direct restorations and patients cannot afford indirect treatment (49, 52, 53). This may exacerbate existing socioeconomic inequalities in oral health (2, 54).

Only two heterogeneous studies met the inclusion criteria; therefore, formal data synthesis was inappropriate. Follow-up was too short to draw meaningful conclusions about tooth or restoration survival, although both studies primarily aimed to assess periodontal outcomes.

Longer-term studies controlling for relevant cavity characteristics are needed to compare approaches for restoring teeth with deep subgingival margins. Development of a risk-based assessment tool that would consider clinical, operator and patient-based variables - and produce a summary that would help convey treatment risk and appropriate treatment options for both clinicians and patients may be helpful in the interim. Health economic evidence examining patient preferences and the cost-effectiveness of different interventions would also support more rational management of these complex cavities.

Conclusion

This systematic review identified only two randomised controlled trials comparing DME followed by indirect, adhesively retained partial-coverage restorations with alternative approaches in posterior teeth with deep subgingival margins. Both were rated at very low certainty of evidence (GRADE). There is therefore a paucity of high-quality randomised controlled trial data on the survival of teeth and restorations treated in this way. This lack of robust clinical evidence makes it difficult to provide clinicians with evidence-based guidance for restoring teeth with deep subgingival margins. It is currently impossible to assert with confidence which approach is most appropriate for the restoration of complex cavities.

Clinical trial number: not applicable

Ethics approval
Not applicable

Consent to participate
Not applicable

Consent for publication
Not applicable

Data availability
The additional data supporting the findings of this study are openly available in Zenodo at https://zenodo.org/records/23211520.

Competing interests
The authors declare no competing interests

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Contributions
All authors contributed to conceptualisation, investigation and validation and critically revised the document. OB, DL and FE performed formal analysis, and OB wrote the original draft.

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