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Restorative Management of Medium to Large Molar Defects Associated with Post Eruptive Enamel Breakdown in Molar-Incisor Hypomineralisation: An Umbrella Review



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Abstract

Objective This umbrella review aimed on first to evaluate whether adhesive composite resin restorations represent the most appropriate treatment for medium and large molar MIH defects following post-eruptive enamel breakdown and, on second, assess whether alternative materials and procedures, including glass ionomer cements, (GICs) and minimally invasive dental hard tissue selective procedures, offer reliable outcomes.
Methods A systematic search of PubMed/MEDLINE, Embase, Scopus, and the Cochrane Database of Systematic Reviews was performed for systematic reviews and meta-analyses published between 2010 and 2025. Eligible studies included children and adolescents with permanent dentition (≤18 years) affected by MIH. The methodological quality of included reviews was assessed using AMSTAR 2. The PRISMA guidelines were followed for study selection and reporting.
Results After screening, seven systematic reviews (one with meta-analysis) were included. AMSTAR 2 quality assessment classified one review as high-quality, three as moderate, one as low, and two as critically low quality. Evidence indicates that adhesive composite resin restorations provide predictable outcomes only when invasive, non-selective removal of hypomineralized enamel is performed.
When isolation is difficult, cooperation is limited, or minimally invasive approaches are preferred, both high-viscosity glass ionomer cements (HV-GICs) and selective approach to MIH affected enamel provide a reliable alternative to MIH defect treatment.
Conclusions Treatment of medium and large MIH defects should be individualized according to enamel quality, patient cooperation, and eruption stage. Adhesive composite resin restorations remain the first-line approach where feasible, while HV-GICs offer a valid alternative for selective and minimally invasive management of MIH defect. Overall, the quality of evidence is moderate to low, highlighting the need for well-designed randomized clinical trials and systematic reviews to strengthen clinical recommendations.

KEYWORDS Molar–Incisor Hypomineralisation (MIH), post-eruptive enamel breakdown, hypomineralised enamel, adhesive composite resin, glass ionomer cement, high-viscosity GIC.

INTRODUCTION

Molar–Incisor Hypomineralisation (MIH) is a qualitative enamel defect that primarily affects the permanent first molars of children and adolescents and is frequently associated with similar defects in permanent incisors. The term MIH was introduced in 2001 to facilitate the classification and recognition of this specific type of enamel defect [Weerheijm et al., 2001].

Histologically, MIH lesions are most commonly characterised by localised areas of pre-eruptive hypomineralised enamel, whereas only the most severe cases involve the entire enamel surface. Clinically, MIH defects present as demarcated opacities that may appear white, creamy-yellow, or brown in colour. The margins of these lesions are typically well defined and, in mild cases, the surface remains smooth and covered by a thin layer of translucent enamel that may appear clinically sound [Bekes, 2021].

In moderate to severe cases, MIH lesions frequently exhibit brown discolouration and enamel disintegration, commonly referred to as post-eruptive enamel breakdown (PEB). These lesions often present with irregular margins and surfaces, with or without exposure of the underlying dentine. In severe MIH cases, enamel breakdown may result in a thin residual enamel layer or direct dentine exposure. These conditions are frequently associated with dentinal hypersensitivity and may significantly impair children's quality of life. Hypersensitivity and enamel breakdown can interfere with eating habits, compromise effective toothbrushing, promote mature dental plaque accumulation, and increase the risk of in situ caries development [Hjertberg et al., 2025; Mazur et al., 2023].

MIH is considered a pre-eruptive developmental defect that occurs during the maturation phase of amelogenesis of permanent first molars and incisors. Histological investigations have shown that hypomineralised enamel is characterised by fewer, shorter, and disorganised hydroxyapatite (HAp) crystals within the enamel rods, increased enamel porosity, and the retention of enamel matrix proteins such as serum albumin and type I collagen. The pathogenesis of MIH has been associated with reduced enzymatic activity responsible for the degradation of enamel matrix proteins during enamel maturation, with a potential role of kallikrein-4 (KLK4) deficiency [Jälevik et al., 2005; Crombie et al., 2013; Daniele, 2025].

Despite extensive research, the precise aetiology of MIH remains unclear. Several potential contributing factors have been proposed and are commonly classified as pre-natal, peri-natal, and post-natal influences. The timing of these disturbances appears to coincide with the mineralisation phase of the enamel shell of permanent first molars and incisors [Garot et al., 2025; Hajdarević et al., 2024].

Several MIH classification systems have been proposed in the literature. Most of these classifications are based on lesion colour, defect extension, and the presence or absence of post-eruptive enamel breakdown [Wetzel and Reckel, 1991; Ghanim et al., 2015]. However, these classifications often provide limited guidance for clinical treatment planning. Other systems combine clinical characteristics, such as colour and enamel loss, with asso-

ciated signs and symptoms including dentinal hypersensitivity and the presence of carious lesions. These approaches aim to guide clinicians in prioritising treatment according to functional difficulties experienced by the patient, such as cold sensitivity or discomfort during toothbrushing, as well as the potential psychosocial impact on affected children. Examples of clinically oriented classifications include the Würzburg concept and the classification proposed by the European Academy of Paediatric Dentistry [Bekes et al., 2023; Lygidakis et al., 2010].

Epidemiological studies have reported a wide variability in MIH prevalence worldwide. A recent systematic evaluation including 99 studies conducted across 43 countries estimated a global mean prevalence of 13.1% (95% CI: 11.7–14.3%) [Schwendicke et al., 2019; Zhao et al., 2018].

Hypomineralised enamel associated with MIH exhibits significantly increased porosity compared with sound enamel, ranging from approximately 5% to 25%. In addition, prism morphology is altered, with reduced prism density, less distinct prism borders, and enlarged interprismatic spaces [Fagrell et al., 2013; Jälevik and Norén, 2000]. These microstructural alterations correspond to substantial changes in both mineral density and chemical composition. Mineral density in MIH-affected enamel is reduced by approximately 20% in mildly affected areas and may exceed a 45% reduction in the most severely compromised regions [Fearne et al., 2004]. Although the calcium-to-phosphate ratio of hydroxyapatite crystals appears to be only minimally affected, MIH enamel shows increased carbon content and a higher proportion of carbonated apatite [Martinović et al., 2015].

Another distinctive feature of MIH-affected enamel is the abnormal retention of proteins involved in amelogenesis, including serum albumin, alpha-fetoprotein, and antitrypsin. These proteins may be present at concentrations up to eight times higher in white and yellow opacities and up to 15–20 times higher in brown lesions [Mangum et al., 2010; Farah et al., 2010].

The altered structural and chemical characteristics of MIH-affected enamel may compromise adhesive procedures. Hypomineralised enamel frequently exhibits irregular or suboptimal etching patterns, which can reduce the effectiveness of bonding procedures, periphery sealing and the longevity of adhesive composite resin restorations. Furthermore, polymerisation shrinkage stresses generated during composite resin curing may contribute to adhesive or cohesive failure at the restoration–tooth interface in MIH-affected enamel [Soares et al., 2017].

Therefore, the restorative management of MIH-affected molars remains clinically challenging, particularly in the presence of medium to large defects associated with post-eruptive enamel breakdown with, often, dentine exposure.

In scientific literature is possible to find some systematic reviews and a recent umbrella review [Bandeira Lopes et al., 2021] that suggested the use of composite resin, resin-based material or glass ionomer cements to restore medium / large MIH's defects after dental enamel post eruptive breakdown. Most of systematic reviews collected on MIH restorative procedures of post eruptive defects present some overlap on the conclusion.

In particular, neither of these publications emphasise a rationale criteria and selection about the use of above cited restorative materials in relationship to removal or leave in situ MIH's affected enamel around the post eruptive breakdown.

Enamel periphery sealing is very important for the longevity of the MIH defect restoration both if defect involving only enamel, or dentine or ex carious lesion dentine removed by either full excavation or selective carious tissue removal.

The primary aim of this umbrella review was to evaluate whether adhesive composite resin restorations represent the most appropriate treatment option for medium to large MIH-affected molars following post-eruptive enamel breakdown. The secondary aim was to assess whether glass ionomer cements (GICs) or high-viscosity glass ionomer cements (HV-GICs) may represent reliable alternatives to composite resin restorations when minimally invasive and dental enamel-selective treatment approaches are adopted..

MATERIALS AND METHODS

Methodology

The study protocol was registered in the PROSPERO (International Prospective Register of Systematic Reviews) database under the registration number CRD420261323468. The umbrella review was conducted and reported in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

Before initiating the literature search, all authors agreed upon a predefined protocol outlining the objectives, eligibility criteria, and methodological procedures of the study.

Eligibility Criteria

The inclusion criteria comprised systematic reviews and meta-analyses investigating Molar–Incisor Hypomineralisation (MIH) associated with post-eruptive enamel breakdown of permanent molars requiring dental intervention due to dentinal hypersensitivity or the development of carious lesions.

The study population included children and adolescents with permanent dentition aged ≤18 years.

One of the included systematic reviews also evaluated hypomineralised second primary molars (HSPM) as a predictive factor for MIH prevalence in permanent molars [Garot et al., 2018].

No restrictions were applied regarding the year of publication; however, only studies published in English were considered eligible, as they were indexed in the databases under consideration.

For all included studies, the research questions were structured according to the PICO framework:

- Population (P): Children and adolescents affected by molar–incisor hypomineralisation (MIH).
- Intervention (I): Adhesive composite resin restorations used for the treatment of medium to large MIH-affected permanent molars after post-eruptive enamel breakdown.
- Comparison (C): Alternative restorative materials, such as glass ionomer cement (GIC) or sealants, used to restore medium and large MIH-affected molars after post-eruptive enamel breakdown.
- Outcome (O): Assessment of the reliability and survival of adhesive composite resin restorations placed using invasive and non-selective techniques in medium and large MIH defects.

Information Sources and Search Strategy

The literature search was conducted in four electronic databases: PubMed/MEDLINE, Embase, Scopus, and the Cochrane Database of Systematic Reviews.

The search strategy involved combinations of relevant keywords relating to MIH and restorative treatments. Both authors used Boolean operators (AND, OR, NOT) to combine the search terms appropriately [Bonczar et al., 2023]. The final searches on databases were conducted in December 2025.

The following search terms were used:

- MIH defect AND restoration

- MIH defect AND composite resin restoration
- MIH defect AND glass ionomer cement restoration selective management of MIH-affected enamel OR non-selective management dental hard tissue adhesion AND MIH-affected enamel

The search was restricted to systematic reviews and meta-analyses published between 2010 and 2025. No systematic reviews specifically addressing the topic of this umbrella review were identified prior to 2010.

To contextualise the findings of this umbrella review, the evidence-based clinical recommendations published by the European Academy of Paediatric Dentistry were also considered during the discussion phase. However, these guidelines were not included in the formal methodological assessment or quantitative synthesis of the umbrella review.

Study Selection and Data Extraction

Two independent reviewers (SD and MHN) screened the titles and abstracts of all retrieved records following prior calibration and agreement on the eligibility criteria.

Studies considered potentially eligible by either reviewer were retrieved in full text and independently assessed for inclusion. Discrepancies between reviewers were resolved through discussion; however, no disagreements occurred during the selection process.

Risk of Bias Assessment

The methodological quality of the included systematic reviews was assessed using the AMSTAR 2 (A MeaSurement Tool to Assess Systematic Reviews) critical appraisal tool [Shea et al., 2017].

AMSTAR 2 is designed to evaluate the methodological quality of systematic reviews that include randomised controlled trials, non-randomised studies of interventions, or both.

According to AMSTAR 2 criteria, the overall confidence in the results of each systematic review was classified into four categories:

High: Zero or one non-critical weakness
Moderate: More than one non-critical weakness
Low: One critical flaw, with or without non-critical weaknesses
Critically low: More than one critical flaw, with or without non-critical weaknesses

The overall confidence rating for each included review was determined using the AMSTAR 2 online assessment tool (https://amstar.ca/mascripts/Calc_Checklist.php).

RESULTS

Study Selection and Characteristics

The umbrella review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [Page et al., 2021]. The electronic search using the selected MeSH terms identified a total of 165 records across the four databases.

After removal of duplicate records, 88 studies remained for title and abstract screening. Following this initial screening phase, 78 records were excluded because they did not meet the eligibility criteria.

A total of 10 full-text articles were retrieved and assessed for eligibility. Among these, three articles were excluded with specific reasons. One excluded study investigated the use of indirect restorations for the management of large MIH defects. The other two excluded papers were evidence-based policy statements published by the European Academy of Paediatric Dentistry, including the original guideline [Lygidakis et al., 2010] and its updated 2022 version [Lygidakis et al., 2022].

Although the updated EAPD guideline was not included in the formal analysis of this umbrella review, its conclusions were considered in the discussion section in order to compare the

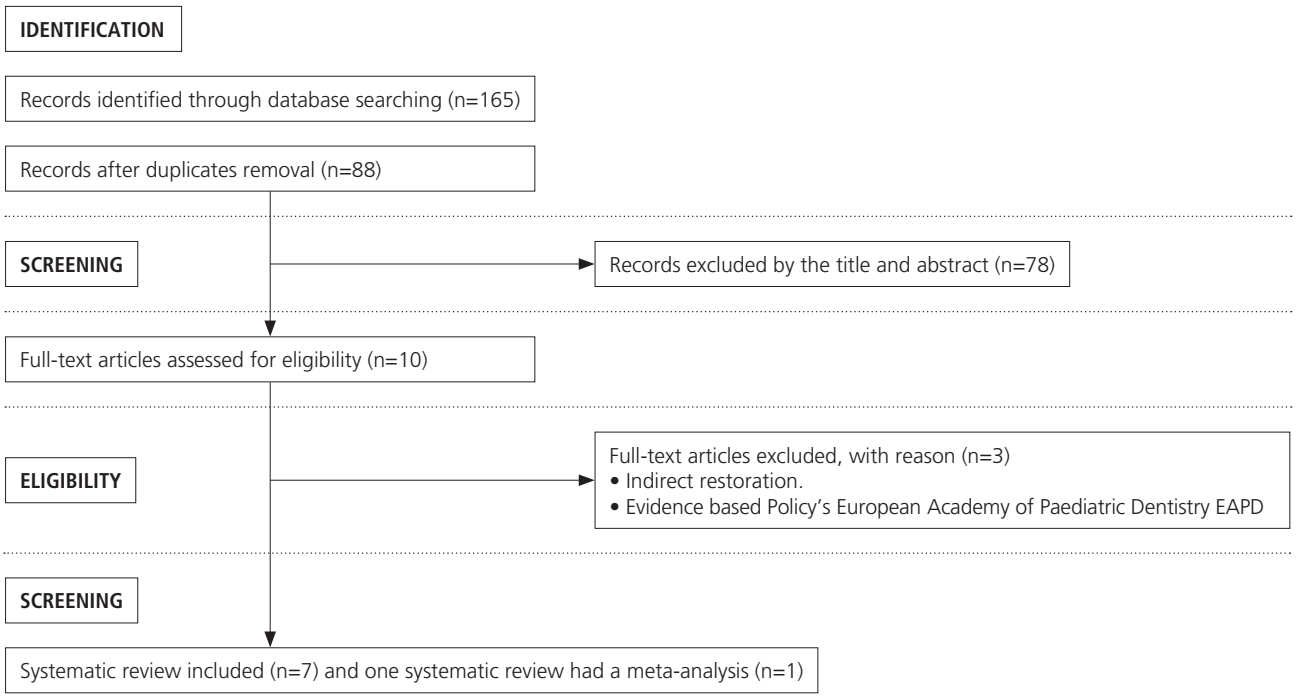


FIG. 1 Flow diagram of study identification, screening, eligibility, and inclusion for the umbrella review

findings of the present review with current evidence-based clinical recommendations.

Only systematic reviews with or without meta-analysis were considered eligible for inclusion. Ultimately, seven systematic reviews met the inclusion criteria and were included in the umbrella review (Fig. 1). Among these, one systematic review included a meta-analysis, as reported in the PRISMA flow diagram (Fig. 1).

The main characteristics of the included systematic reviews are summarised in Table 1.

Risk of Bias

The methodological quality of the included studies was evaluated using the AMSTAR 2 criteria.

The EAPD policy considered as comparative guideline for clinically approach to MIH defect restoration was not included in the AMSTAR 2 assessment because it represented an evidence-based policy statement of the European Academy of Paediatric Dentistry, and therefore did not meet the methodological requirements necessary for evaluation within the AMSTAR 2 domains [Lygidakis et al., 2022].

Consequently, seven systematic reviews were assessed using the AMSTAR 2 tool. Among these, one systematic review fulfilled all AMSTAR 2 criteria and was classified as high quality [Pascareli-Carlos et al., 2025]. Three reviews were rated as having moderate methodological quality [Somani et al., 2022; Elhennawy

Author (Year)	Search period	Type /No of studies included	N. (drop out)	Exposure	Tool used for quality assesment	Method of analysis	Outcomes	Findings
Somani C. et al. (2022)	1980-2020	4 Randomized trial 2 Retrospective case-control 5 Retrospective cohort 5 Prospective cohort	652 (52)	Intervention with resin-based sealant, composite resin and glass-ionomer cement GIC or HvGIC for direct management of molar MIH's defects	ROBINS-I Tool. RoB 2 Tool for Randomised trials	SR	Success % of the intervention	There is convincing evidence to support the use of resin-based fissure sealants, direct composite resin restoration for MIH-affected molars in specific clinical scenarios
Elhennawy K. et al. (2016)	1980-2016	2 Randomized controlled trial RCT 4 Prospective cohort 4 Retrospective cohort	381 (n/a)	Intervention with all therapy available for molar's MIH defects. Resin-based sealant, composite resin and glass-ionomer cement GIC direct restorations that were take in account.	Cochrane Risk of Bias Tool	SR	Success % of the intervention	For MIH-affected molars a non invasive and invasive restorative options are available. The indication for which should be based on the severity of MIH and hypersensitivity. For direct restoration composte resin seem suitable and GIC may be used for temporization of teeth, e.g in cases of diffucult moisture control during eruption.
Inchingolo AM et al (2023)	2013-2023	23 Randomized controlled trial RCT 1 Clinical trial	1440 (n/a)	All type of available treatments for MIH affected teeth. Only MIH-affected molars direct restoration interventions were take in account	ROBINS-I Tool	SR	Success % of the intervention. Favorable or no favorable short-term results	The evidence collected indicates that the treatment of MIH-affected molars should be customized according to the severity of the case, the age of the patient and other individual and tooth variables.

TAB. 1A Risk of bias of systematic review (AMSTAR 2) tool. 0: No meta-analysis conducted, N: No, Y: Yes, PY: Partial Yes.

Author (Year)	Search period	Type /No of studies included	N. (drop out)	Exposure	Tool used for quality assesment	Method of analysis	Outcomes	Findings
Pascareli-Carlos AM et al. (2025)	Up to 2003	8 Randomized controlled trial RCT 3 Retrospective cohort 1 Prospective cohort 3 Non randomized interventional studies	895 (n/a)	Different treatment approaches for posterior teeth affected by developmental defects of enamel DDE, presenting with dentin cavities or post eruptive fractures in order to identify the most effective treatment. Only DDE-affected molars direct restoration interventions were take in account	Cochrane Risk of Bias Tool. ROBINS- I tool for non-randomized interventions studies	SR and Meta-Analysis	Success % of the intervention.	Composite resin and GIC restoration may be a viable treatment options for the management of molar's MIH defects and other types of DDE.
Lygidakis NA. (2010)	2000-2009	1 Clinical Prospective 1.Eighteen cases were clinical prospective, twentyfour cases were splith mouth. 1 Retrospective with controls 1 Prospective 1 Retrospective 1 Prospective, half mouth double blind	270 (n/a)	Treatment modalities to restore molar MIH defects. Only resin-based sealant, composite resin and GIC restorations were take in account.	n/a	SR	Success % of the intervention	In mild and moderate MIH cases, direct composite restorations using modern adhesives is the treatment of choice and may last for many years until permanent restorations may placed. In severe cases transitional treatment and materials for function can be provided.
Denis R. et al. (2025)	2013-2024	15 considered as case-report 7 Clinical trials 4 Prospective studies 2 Retrospective studies	896 (n/a)	To compare the different materials used for direct restorations on teeth with MIH. Only MIH molars situation was take in account.	Joanna Briggs Institute (JBI) tool	SR	Success % of the intervention	The management of patient with MIH is complex and must be considered on a case-by-case. The treatment decision will depend on many factors, such age, compliance, severity of enamel breakdown, dental development and many others. For erupting molars, GIC seem to give the best results in limited defects, until a resin composite can be placed under a good sealing conditions

TAB. 1B Risk of bias of systematic review (AMSTAR 2) tool. 0: No meta-analysis conducted, N: No, Y: Yes, PY: Partial Yes.

Author (Year)	Search period	Type /No of studies included	N. (drop out)	Exposure	Tool used for quality assesment	Method of analysis	Outcomes	Findings
Bandeira Lopes L. et al. (2021)	2003-2020	12 Systematic review 6 Systematic review with meta-analisys.	161125	To evaluate the different approach and materials for direct restoration in MIH defects. Only restorations of MIH-affcted molars were take in account	AMSTAR 2 tool	Umbrella review	Finding of the review.	To make a composite restoration is a reasonable treatment approach for several reasons, like isolation and sealing dentine and desensitization, although low adhesion to enamel and risk of marginal breakdown of restorations may still be a challenges.

TAB. 1C Risk of bias of systematic review (AMSTAR 2) tool. 0: No meta-analysis conducted, N: No, Y: Yes, PY: Partial Yes.

First author	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Review quality
Somani C. et al. (2022)	Y	PY	Y	PY	Y	Y	Y	Y	Y	N	0	0	Y	Y	0	Y	Moderate
Elhennawy K. et al. (2016)	N	PY	Y	PY	Y	Y	Y	Y	Y	N	0	0	Y	Y	0	Y	Moderate
Inchingolo AM et al (2023)	N	PY	Y	PY	Y	Y	N	Y	Y	N	0	0	Y	Y	0	Y	Low
Pascareli-Carlos AM et al. (2025)	Y	Y	Y	PY	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Lygidakis NA. (2010)	N	N	Y	PY	N	N	N	Y	N	N	0	0	N	Y	0	N	Critically Low
Denis R. et al. (2025)	N	PY	Y	N	Y	Y	N	N	PY	N	0	0	Y	N	0	N	Critically Low
Bandeira Lopes L. et al. (2021)	Y	Y	Y	PY	Y	Y	Y	Y	Y	N	0	0	Y	Y	0	Y	Moderate

TAB. 2 Risk of bias of systematic review (AMSTAR 2) tool. 0: No meta-analysis conducted, N: No, Y: Yes, PY: Partial Yes

and Schwendicke, 2016; Bandeira Lopes et al., 2021], one review was classified as low quality [Inchingolo et al., 2023], and two reviews were assessed as having critically low quality [Lygidakis, 2010; Denis et al., 2025] (Table 2).

Overall, the principal methodological concern identified across the included studies relates to the difficulty of achieving durable and reliable adhesion to hypomineralised enamel in MIH-affected teeth. The porous structure and presence of microcracks within MIH enamel may compromise bond strength and increase the risk of restoration failure, particularly due to cohesive fractures occurring within the hypomineralised enamel substrate with loss of restoration periphery sealing.

Synthesis of results

The restorative management of molars affected by Molar–Incisor Hypomineralisation represents a significant clinical challenge for paediatric dentists. Treatment strategies must address not only the restoration of the structural defect but also the management of dentinal hypersensitivity and the achievement of satisfactory medium- to long-term clinical outcomes in terms of restoration survival and success.

One of the main clinical challenges is achieving effective and durable adhesion to hypomineralised enamel, which is characterised by increased porosity and the presence of microstructural defects such as microcracks. These structural alterations reduce bond strength and increase the likelihood of restoration failure due to cohesive fractures within the weakened enamel substrate [William et al., 2006].

Complete removal of hypomineralised enamel, together with any carious dentine, may expose a more stable substrate that is more receptive to adhesive procedures. This approach is generally considered an invasive, non-selective treatment strategy, as it involves the removal of all structurally compromised enamel.

The findings of the present umbrella review suggest that optimal adhesion to MIH-affected enamel may be achieved using two-step self-etch adhesive systems or three-step etch-and-rinse adhesives when affected is removed in order to find sound and etching enamel.

These adhesive systems DBAs are still considered a most suitable strategy for adhesive procedures to dental hard tissue in restorative dentistry

The use of enamel deproteinisation to remove retained enamel matrix proteins has shown inconsistent results. Some studies have reported that pre-treatment with 5% sodium hypochlorite (NaOCl) following acid etching may improve bond strength by increasing the surface area available for infiltration by dental bonding agents (DBAs). However, other studies, primarily conducted in vitro, have reported that deproteinisation procedures may not improve adhesion and may even reduce bond strength values (MPa) [Inchingolo et al., 2023; Lygidakis, 2010; Denis et al., 2025; Bandeira Lopes et al., 2021].

Most of the systematic reviews included in this umbrella review

indicate that adhesive composite resin restorations may represent a predictable treatment option, with moderate to high clinical success rates when the most severely compromised MIH enamel is completely removed using invasive, non-selective techniques [Somani et al., 2022; Inchingolo et al., 2023; Pascareli-Carlos et al., 2025; Lygidakis, 2010; Denis et al., 2025; Bandeira Lopes et al., 2021]. This procedure typically involves the use of rotary instruments to eliminate hypomineralised enamel that could compromise bond strength or increase the risk of marginal failure and secondary caries. Pascareli-Carlos et al. [2025] emphasised that composite resin adhesive restorations should preferably be performed only when complete removal of hypomineralised enamel can be achieved.

For moderate MIH defects, fissure sealants may represent an alternative treatment option; however, the MIH enamel–adhesive interface remains more porous and susceptible to cohesive fracture compared with sound enamel, resulting in relatively high annual failure rates [Elhennawy and Schwendicke, 2016]. Similarly, the clinical recommendations of the European Academy of Paediatric Dentistry highlight that reduced bond strength in MIH enamel may negatively affect the long-term success of composite resin restorations [Lygidakis et al., 2022].

However, invasive restorative procedures require adequate patient cooperation, which may not always be achievable in paediatric patients [Linner et al., 2020].

Glass ionomer cements (GICs) provide moderate mechanical retention in irregular MIH defects following enamel breakdown and establish a chemical bond with hydroxyapatite crystals through the ionic interaction between calcium ions in dental hard tissues and polyalkenoic acid groups present in the material [Durrant et al., 2024]. In addition, GICs release fluoride and can be recharged with fluoride ions, providing a potential protective effect against caries development. Nevertheless, conventional GICs exhibit inferior mechanical properties compared with composite resins and may demonstrate higher solubility in the oral environment.

To address these limitations, high-viscosity glass ionomer cements (HV-GICs) have been developed. These materials present improved mechanical properties, increased resistance to masticatory forces, and reduced solubility [Hill, 2022; Huang et al., 2025].

Minimally invasive and selective approaches may involve partial removal of hypomineralised enamel, often using hand instruments, while preserving as much enamel and leathery / firm dentine as possible. The resulting cavity may then be restored using GIC according to the atraumatic restorative treatment (ART) technique [Garbim et al., 2021].

Several systematic reviews included in this umbrella review suggest that when MIH-affected molars are partially erupted, when effective moisture control cannot be achieved, or when patient cooperation is limited, minimally invasive restorations using GICs may represent a reliable temporary treatment option. These restorations may be maintained until full eruption of the tooth and improved patient cooperation allow an invasive approach to MIH defect and the placement of more definitive adhesive restorations or indirect restorations for larger defects [Somani et al., 2022; Elhennawy and Schwendicke, 2016; Pascareli-Carlos et al., 2025; Denis et al., 2025; Lygidakis et al., 2022].

Fluoride release from GICs may contribute to the prevention of caries development in MIH-affected enamel. Two systematic reviews and an additional study indicate that modern HV-GIC materials demonstrate promising properties, including reduced solubility and sufficient resistance to moderate masticatory forces, with acceptable short- to medium-term restoration survival [Pascareli-Carlos et al., 2025; Lygidakis et al., 2022; Grossi et al., 2018].

DISCUSSION

This umbrella review synthesises the current evidence regarding the effectiveness of adhesive composite resin restorations for the management of molar MIH defects. The methodological quality of the included systematic reviews varied from high to critically low, with one review providing high-level evidence and three reviews providing moderate-level evidence. Overall, the available evidence is limited, and the confidence in these findings is therefore considered low to moderate.

The objectives of this umbrella review take in account whether a selective or non-selective approach is used to remove MIH affected dental enamel as a criterion for selecting the most appropriate restorative material.

The results of this umbrella review indicate that adhesive composite resin restorations can be a reliable clinical option only when MIH defects are fully treated using invasive, non-selective procedures, ensuring that the prepared cavity consists of dental hard tissue comparable to sound enamel for an optimal periphery restoration sealing.

The primary challenges associated with composite resin restorations in MIH-affected teeth are the reduced bonding potential of hypomineralised enamel and polymerisation shrinkage, which may lead to restoration detachment, marginal infiltration, and consequently reduced restoration survival and clinical success [Soares et al., 2017].

High-viscosity glass ionomer cements (HV-GICs), which demonstrate improved mechanical properties and reduced solubility compared with conventional GICs, represent a viable alternative in situations where effective moisture control is difficult or patient cooperation is limited. These materials are particularly suitable for minimally invasive approaches that selectively preserve MIH-affected enamel, providing a pragmatic and preventive treatment option in challenging clinical scenarios.

Based on the evidence synthesised in this umbrella review, the first aim, to determine whether adhesive composite resin restorations are universally the optimal treatment for medium to large MIH defects, is only partially supported. In contrast, the second aim, regarding the use of HV-GICs as a valid alternative in minimally invasive and MIH affected enamel selective approaches, is fully supported by the available evidence.

Strengths and limitations

This umbrella review has several strengths. It provides a comprehensive synthesis of published systematic reviews evaluating the different restorative materials used for medium and large molar MIH defects, highlighting the clinical implications of both invasive and minimally invasive approaches.

However, several limitations should be acknowledged. The individual studies included within each systematic review were not analysed in detail, which may limit the granularity of the findings. The highest-quality systematic review included in this umbrella review was classified as high-level evidence according to the AMSTAR 2 tool [Pascareli-Carlos et al., 2025]. Nevertheless, the authors of this review noted that many of the primary studies they analysed exhibited high or critical risk of bias, which affects the overall reliability of the evidence.

The remaining systematic reviews included in this umbrella review were assessed as having moderate, low, or critically low methodological quality, which contributed to a moderate-to-low overall level of evidence for the conclusions drawn in this work.

Additionally, a previous umbrella review on MIH [Bandeira Lopes et al., 2021] was considered in this study. However, that review did not explicitly differentiate restorative approaches according to selective versus non-selective treatment of MIH-affected enamel, which is a critical factor in determining the most appropriate material for MIH defect restoration. The present umbrella review provides additional data that may help to complement and refine the conclusions of the previously published MIH umbrella review [Bandeira Lopes et al., 2021].

CONCLUSIONS

- Composite resin restorations may provide a reliable clinical option for molar MIH defects. However, predictable outcomes require an invasive, non-selective approach with complete removal of hypomineralised enamel to achieve effective peripheral sealing and ensure medium- to long-term restoration survival.
- Clinical challenges in paediatric patients include difficulty in isolating MIH-affected molars from oral fluids and achieving proper adhesive bonding, particularly in partially erupted teeth. Limited cooperation in young children further complicates restorative procedures in the molar region.
- Alternative restorative approaches are indicated when adhesive composite resin restorations are not feasible due to eruption stage, patient cooperation, or other clinical constraints. In such cases, a minimally invasive and selective approach, preserving portions of hypomineralised enamel, may be justified. Glass ionomer cements (GICs) are recommended for these scenarios, as they adapt to the irregular morphology of MIH-affected cavities and establish a chemical bond with calcium in hydroxyapatite of enamel and dentine. The release of fluoride from GICs provides an additional benefit in preventing the development of secondary caries at the interface between the defect and the restoration.
- High-viscosity GICs (HV-GICs) offer improved mechanical properties and reduced solubility compared with conventional GICs, making them suitable for stress-bearing areas.
- Future research priorities include conducting well-designed randomised controlled trials and high-quality systematic reviews with larger sample sizes, extended follow-up periods, standardised outcome measures, and low risk of bias. Such studies are essential to provide robust evidence for optimising restorative strategies in MIH-affected molars.

Disclosure statement

No potential conflict of interest was reported by the authors.

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