LUMEN ET VIRTUS
ISSN: 2177-2789

MOLAR-INCISOR HYPOMINERALIZATION ASSOCIATED WITH CLEFT LIP AND PALATE: CLINICAL EVIDENCE AND MANAGEMENT PERSPECTIVES

HIPOMINERALIZAÇÃO MOLAR INCISIVO ASSOCIADA À FISSURA LABIOPALATINA: EVIDÊNCIAS CLÍNICAS E PERSPECTIVAS DE MANEJO

HIPOMINERALIZACIÓN MOLAR-INCISIVA ASOCIADA A LA FISURA LABIOPALATINA: EVIDENCIAS CLÍNICAS Y PERSPECTIVAS DE MANEJO

https://doi.org/10.56238/levv16n54-178

Submitted on: 10/30/2025 **Publication date:** 11/30/2025

Diana Monge Martinez[1], Eloá Cristina Passucci Ambrosio[2], Nádia da Rocha Svizero[3], Maria Aparecida Andrade Moreira Machado[4], Thais Marchini Oliveira[5], Natalino Lourenço Neto[6]

ABSTRACT

Cleft lip and palate are common congenital defects, affecting approximately one in every 650 live births in Brazil. In parallel, molar-incisor hypomineralization (MIH) is a defect that manifests as demarcated opacities that often affect the tooth enamel of first molars and permanent incisors. In patients with cleft lip and palate, factors such as bone graft surgery can contribute to MIH, which has a significantly high prevalence in this group. This study aimed to conduct a literature review on incisive molar hypomineralization in patients with cleft lip and palate, analyzing its prevalence compared to individuals without fissure, risk factors, clinical implications, challenges in the management and treatment of the condition. To this end, the review analyzed publications in databases such as PubMed/Medline, Scielo, and Scopus, using the following terms: MIH; pediatric dentistry; hypomineralization; cleft lip and palate; dental treatment; rehabilitation; and prevention. Results showed that, in the first stage, seven studies related MIH to cleft lip and palate, pointing to a higher prevalence in more complex cases, without addressing clinical management. In the second stage, nine

[1] Multiprofessional Resident in Craniofacial Syndromes and Anomalies. Hospital de Reabilitação de Anomalias Craniofaciais. Universidade de São Paulo (HRAC/USP). E-mail: diana.monge@usp.br Orcid: https://orcid.org/0009-0008-9583-8223 Lattes: http://lattes.cnpq.br/4612405695966216
[2] Dr. in Applied Dental Sciences. Hospital de Reabilitação de Anomalias Craniofaciais. Universidade de São Paulo (HRAC/USP). E-mail: eloacpambrosio@usp.br Orcid: https://orcid.org/0000-0003-2322-3832 Lattes: http://lattes.cnpq.br/5269731938926723
[3] Dr. in Applied Dental Sciences. Hospital de Reabilitação de Anomalias Craniofaciais. Universidade de São Paulo (HRAC/USP). E-mail: nsvizero@usp.br Orcid: https://orcid.org/0000-0002-1663-3983 Lattes: http://lattes.cnpq.br/5567568706294178
[4] Professor. Departamento de Odontopediatria, Ortodontia e Saúde Coletiva. Universidade de São Paulo (FOB/USP). E-mail: mmachado@fob.usp.br Orcid: https://orcid.org/0000-0003-3778-7444 Lattes: http://lattes.cnpq.br/2141932552644466
[5] Professor. Departamento de Odontopediatria, Ortodontia e Saúde Coletiva. Universidade de São Paulo (FOB/USP). Hospital de Reabilitação de Anomalias Craniofaciais. Universidade de São Paulo (HRAC/USP). E-mail: marchini@usp.br Orcid: https://orcid.org/0000-0003-3460-3144 Lattes: http://lattes.cnpq.br/5133729913926567
[6] Professor. Departamento de Odontopediatria, Ortodontia e Saúde Coletiva. Universidade de São Paulo (FOB/USP). E-mail: natalinoneto@usp.br Orcid: https://orcid.org/0000-0003-0227-0349 Lattes: http://lattes.cnpq.br/7323464373296854

high-evidence studies on the prevention and treatment of MIH in the general population were included, with protocols that could be adapted to patients with cleft lip and palate. In conclusion, MIH is more prevalent in patients with cleft lip and palate, especially in cases involving the palate and bilateral clefts. This condition compromises function, aesthetics, and quality of life, requiring individualized management with preventive strategies, sensitivity control, and adequate restorations.

Keywords: Molar Hypomineralization. Cleft Lip. Cleft Palate. Mouth Rehabilitation. Pediatric Dentistry.

RESUMO

As fissuras labiopalatinas são defeitos congênitos comuns, afetando cerca de uma em cada 650 crianças nascidas vivas no Brasil. Paralelamente, a hipomineralização molar incisivo (HMI) é um defeito que se manifesta como opacidades demarcadas que afetam frequentemente o esmalte dentário de primeiros molares e incisivos permanentes. Em pacientes com fissura labiopalatina, fatores como cirurgias de enxerto ósseo podem contribuir para HMI, que apresenta uma prevalência significativamente elevada nesse grupo. Objetivou-se revisar a literatura sobre a hipomineralização molar incisivo em pacientes com fissura labiopalatina, analisando sua prevalência comparado à indivíduos sem fissura, fatores de risco, implicações clínicas, desafios no manejo e tratamento da condição. Para tanto, a revisão analisou publicações em bases de dados como PubMed/Medline, Scielo e Scopus, utilizando termos: HMI; Odontopediatria; hipomineralização; fissura labiopalatina; tratamento odontológico; reabilitação; e prevenção. Observou-se na primeira etapa, 7 estudos que relacionaram a HMI à fissura labiopalatina, apontando maior prevalência em casos mais complexos, sem abordar manejo clínico. Na segunda, 9 estudos de alta evidência sobre prevenção e tratamento da HMI na população geral foram incluídos, com protocolos passíveis de adaptação a pacientes com fissura. Conclui-se que a HMI é mais prevalente em pacientes com fissura labiopalatina, sobretudo nos casos com envolvimento do palato e fissuras bilaterais. Essa condição compromete função, estética e qualidade de vida, demandando manejo individualizado com estratégias preventivas, controle da sensibilidade e restaurações adequadas.

Palavras-chave: Hipomineralização Molar. Fenda Labial. Fissura Palatina. Reabilitação Bucal. Odontopediatria.

RESUMEN

Las fisuras labiopalatinas son defectos congénitos comunes, que afectan aproximadamente a uno de cada 650 niños nacidos vivos en Brasil. Paralelamente, la hipomineralización molar-incisiva (HMI) es un defecto que se manifiesta como opacidades delimitadas que afectan con frecuencia el esmalte dental de los primeros molares y de los incisivos permanentes. En pacientes con fisura labiopalatina, factores como las cirugías de injerto óseo pueden contribuir al desarrollo de la HMI, que presenta una prevalencia significativamente elevada en este grupo. Se objetivó revisar la literatura sobre la hipomineralización molar-incisiva en pacientes con fisura labiopalatina, analizando su prevalencia en comparación con individuos sin fisura, los factores de riesgo, las implicaciones clínicas, los desafíos en el manejo y el tratamiento de la condición. Para ello, la revisión analizó publicaciones en bases de datos como PubMed/Medline, SciELO y Scopus, utilizando los términos: HMI; Odontopediatría; hipomineralización; fisura labiopalatina; tratamiento odontológico; rehabilitación; y prevención. Se observó en la primera etapa siete estudios que relacionaron la HMI con la fisura labiopalatina, señalando una mayor prevalencia en casos más complejos, sin abordar el manejo clínico. En la segunda etapa, se incluyeron nueve estudios de alta evidencia sobre prevención y tratamiento de la HMI en la población general, con protocolos susceptibles de adaptación a pacientes con fisura. Se concluye que la HMI es más prevalente en pacientes

con fisura labiopalatina, sobre todo en los casos con afectación del paladar y fisuras bilaterales. Esta condición compromete la función, la estética y la calidad de vida, exigiendo un manejo individualizado con estrategias preventivas, control de la sensibilidad y restauraciones adecuadas.

Palabras clave: Hipomineralización Molar. Fisura Labial. Fisura Palatina. Rehabilitación Bucal. Odontopediatría.

1 INTRODUCTION

Cleft lip and palate (CLP) are among the most common craniofacial birth defects affecting the human face, occurring in approximately one in every 650 live births in Brazil (VERAS et al., 2021). This number can vary depending on geographic location, socioeconomic status, ethnicity, and race (DIXON et al., 2011). The etiology of cleft lip and palate is influenced by a variety of factors. Any element—physical, chemical, or biological—that interferes with the processes of differentiation, migration, and multiplication of neural crest cells and compromises the facial mesenchyme may contribute to the occurrence of these malformations (FREITAS et al., 2012).

Similarly, other disturbances in craniofacial and dental development may result in structural defects, as seen in the condition known as molar-incisor hypomineralization (MIH). This anomaly refers to a systemic developmental defect that affects one or more first permanent molars, and may also involve the permanent incisors (ALMULHIM et al., 2021). Clinically, the affected teeth may exhibit different shades of opacity, ranging from a chalky white to yellowish or brownish tones (INCHINGOLO et al., 2023).

Molar-incisor hypomineralization is strongly associated with the occurrence of dental caries, as the opacities present in MIH are hypomineralized and porous regions that facilitate the accumulation of bacterial plaque (WEERHEIJM et al., 2003). In addition, the frequent hypersensitivity of these teeth can lead children to neglect oral hygiene, resulting in greater accumulation of food debris (WEERHEIJM et al., 2003). This enamel degradation, which exposes the dentin, makes the teeth more susceptible to the development of caries (WEERHEIJM et al., 2003).

The etiology of MIH is associated with a wide range of factors, including perinatal events, exposure to fluoride, specific childhood and chronic diseases, early childhood exposure to toxins such as dioxins and biphenyls, among others (CROMBIE et al., 2009). In patients with CLP, the literature reports a possible association between alveolar bone graft (ABG) surgeries and cleft lip and/or palate itself, combined with postnatal environmental factors, as one of the potential causes of enamel developmental defects (MACIEL et al., 2005; DIXON et al., 1968).

The average global prevalence of MIH is 13.1%, with variations depending on geographical location (SCHWENDICKE et al., 2017). The prevalence of molar-incisor hypomineralization in individuals with cleft lip and palate is significantly higher, reaching 67% (WANDERLEY et al., 2024). Moreover, the severity of the cleft also influences the frequency and number of affected molars, highlighting the complexity of this condition (WANDERLEY et al., 2024).

This literature review aims to compile research on molar-incisor hypomineralization in patients with cleft lip and palate. The prevalence of MIH is significantly higher in this group, highlighting the need for specific clinical attention, especially due to its association with an increased risk of dental caries, thus justifying the execution of the present study. Understanding this condition is essential for evaluating effective prevention and treatment strategies, considering that the severity of the cleft can influence the frequency and severity of MIH. This underscores the complexity of the condition and the importance of identifying subgroups that require more intensive care.

The aim of this study was to conduct a literature review on molar-incisor hypomineralization in patients with cleft lip and palate, analyzing the prevalence in this group compared to individuals without cleft, associated risk factors, clinical implications, challenges in management, and treatment of the condition.

2 MATERIAL AND METHODS

This literature review conducted a detailed analysis of existing publications in the PubMed/Medline, Scielo, and Scopus databases. The search strategy used DeCS/MeSH descriptors related to molar incisor hypomineralization, cleft lip, cleft palate, prevention, rehabilitation, and dental treatment, as well as their alternative terms, combined according to the syntax of each database.

The search in the first part focused on articles related to the etiology and prevalence of MIH in patients with CLP, using specific terms for both topics. For this stage, articles published in the last 10 years (2015–2025) were included, aiming to broaden the capture of relevant publications given the limitation of specific literature on the subject. In the second part, the search focused on articles addressing rehabilitation strategies, clinical implications, and treatments for MIH in the general population, using descriptors related to dental treatments, clinical outcomes, rehabilitation, and therapeutic efficacy. For this stage, the time filter was restricted to the last 2 years (2023–2025) to gather the most current evidence on the clinical management of MIH. Additionally, priority was given to articles with higher levels of scientific evidence, such as randomized clinical trials, systematic reviews, and observational studies relevant to clinical practice.

In both searches, publications were manually selected based on the reading of abstracts, following these inclusion criteria: scientific articles published within the specified period, with full-text access, in English and Portuguese. Duplicate studies and those that did not have a direct relation to the study objectives were excluded.

3 RESULTS

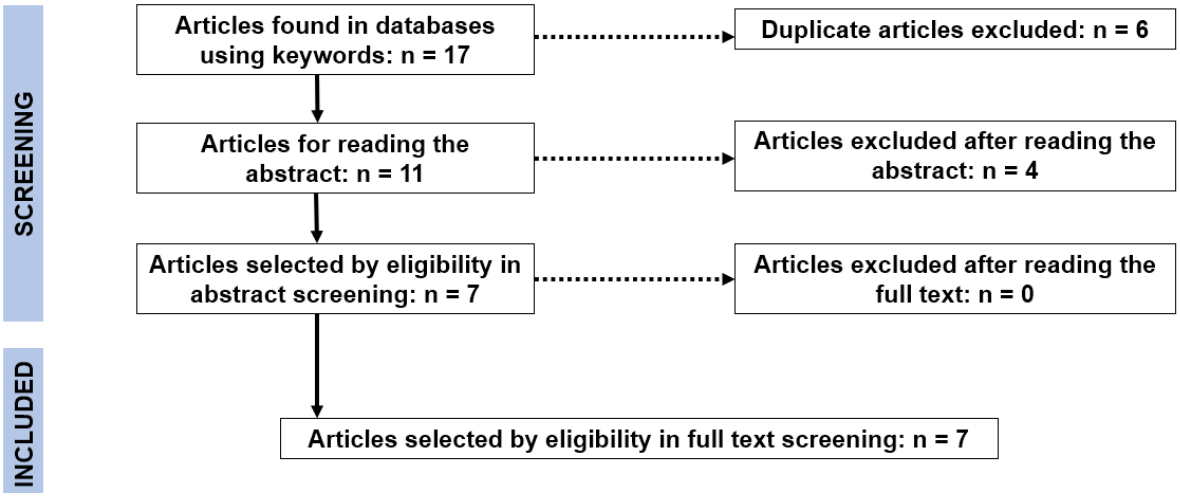
The present review was conducted in two distinct stages, according to the focuses of the investigation.

Molar-incisor hypomineralization in patients with cleft lip and palate

The first search strategy initially yielded seventeen scientific articles relating MIH to patients with cleft lip and palate. Six duplicate articles and four articles unrelated to the proposed topic were excluded. Thus, seven studies were selected to compose this stage of the analysis (Figure 1).

Figure 1

Flow diagram of articles identified in the first search strategy



Source: Prepared by the authors.

These articles predominantly addressed the prevalence of MIH in this population, showing a possible correlation between the extent and complexity of the cleft and the increase in the number of affected teeth (Table 1).

Table 1

Articles selected in the first stage, according to inclusion and exclusion criteria

Authors	Study location	Study design	Sample	Diagnostic criteria for MIH	Prevalence of MIH	Associated factors	Conclusions
Lacerda, W. R. H. et al. (2024)	Brazil (PB)	Transversal	386 individuals with CLP, aged 6-20 years	EAPD Diagnosis	67%	Cleft type	High prevalence; association between cleft complexity and number of affected molars

Authors	Study location	Study design	Sample	Diagnostic criteria for MIH	Prevalence of MIH	Associated factors	Conclusions
Farias, A. et al. (2023)	Brazil (Araraquara /SP)	Cross-sectional retrospective (photo)	290 individuals with CLP, aged, 3-14 years.	Ghanim Index, examination of demarcated hypomineralization (MIH)	52.1% hypomineralization (not necessarily MIH)	Severity of the cleft	Demarcated hypomineralization was the most common enamel development defect
Allam, E. et al. (2018)	USA	Cross-sectional retrospective (photo)	41 individuals with CLP and 60 individuals without CLP, aged 6-16 years	Modified Weerheijm criteria	Incisors were more affected by MIH in individuals who underwent primary alveolar bone grafting compared to secondary grafting	Type of alveolar bone graft: the primary is associated with more severe MIH	Individuals with CLP have more MIH than controls; Primary Alveolar Bone Grafting is associated with more severe MIH compared to secondary grafting
Farias. A. et al. (2025)	Brazil (Araraquara /SP)	Cross-sectional retrospective (photo)	290 individuals with CLP, aged, 3-14 years.	Ghanim Index	8.1% of permanent teeth with MIH	Cleft lip and palate, isolated cleft palate, maxillary dental arch	Individuals with CLP have a high prevalence of MIH in the upper dental arch, associated with more severe cleft phenotypes
Koruyucu. M. et al. (2018)	Turkey (Istanbul)	Genetic study	1573 individuals with CLP	EAPD Diagnosis	335 individuals with CLP and MIH	A relationship between CLP and MIH is suggested, but there is no definitive conclusion about the associated mechanisms	CLP and MIH may share common mechanisms, indicating a possible syndromic spectrum
Knaap-Kind. L. S. et al. (2024)	Netherlands (Rotterdam)	Cross-sectional retrospective (photo)	516 individuals with CLP	Ghanim Index	12.8%, among them 57% were present in a more severe form in the upper dental arch	There were no differences in the prevalence of MIH by type of cleft.	There was no association between the type of cleft and increased risk of MIH

Authors	Study location	Study design	Sample	Diagnostic criteria for MIH	Prevalence of MIH	Associated factors	Conclusions
Bhatia. N. et al. (2024)	India	Cross-sectional retrospective (photo)	47 individuals with CLP	Modified Weerheijm criteria	83.1% exhibited some form of enamel hypomineralization	No differences were found between the cleft and non-cleft sides, except for the maxillary lateral and central incisors	Higher prevalence of MIH in individuals with CLP

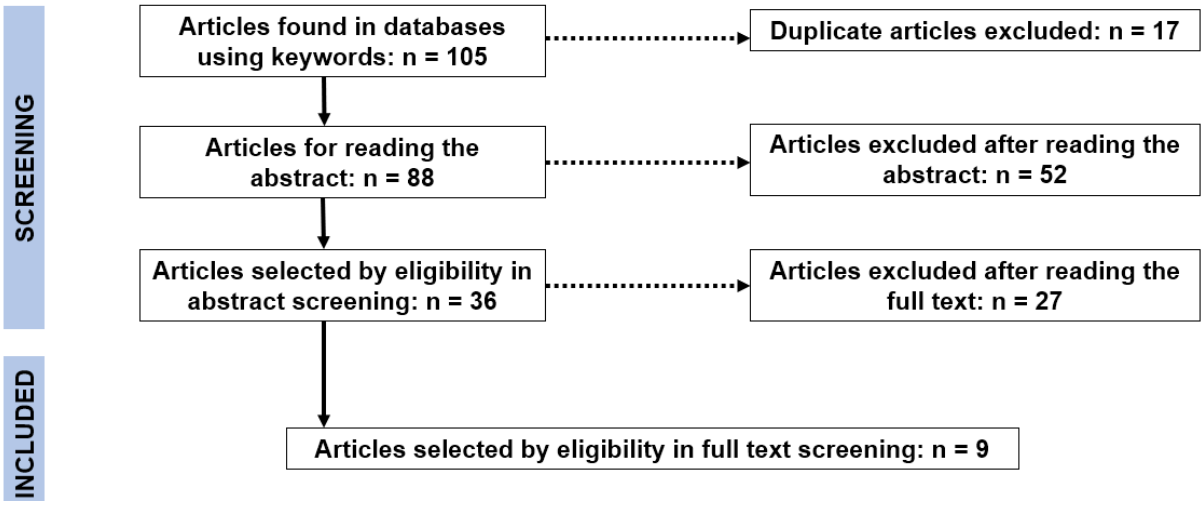
Source: Prepared by the authors.

MIH in the general population: prevention, clinical management, and rehabilitation

A total of 105 articles were identified in the databases consulted. Of these, 17 were excluded due to duplication and 52 for not being directly related to the theme. Thus, 36 articles remained for analysis, of which 27 were excluded after reading the full text. Consequently, 9 studies were included in the second search strategy (Figure 2, Table 2).

Figure 2

Flow diagram of articles identified in the second search strategy



Source: Prepared by the authors.

Table 2

Articles selected in the second stage, according to inclusion and exclusion criteria.

Authors	Study design	Sample	Material/Technique evaluated	Outcomes analyzed	Results
Cerqueira N. M. et al (2025)	Systematic Review	7 articles	Low laser therapy (LLT)	Impact of laser therapy on the treatment of dentin hypersensitivity in teeth with MIH	Combinations of LLT and desensitizing agents reduce long-term hypersensitivity, while LLT alone shows an immediate effect in teeth with MIH
Nefzaoui M. et al (2025)	Systematic Review	12 articles	Resin infiltration and microabrasion (with or without remineralizing agents)	To evaluate aesthetic alternatives for hypomineralized incisors	Both therapeutic options demonstrate efficacy
Mahfouz R.A. et al (2025)	Randomized controlled clinical trial	Children aged 7 to 10 years with MIH. Inclusion of 88 molars	Zirconia-reinforced glass ionomer (ZrGI) and hybrid glass ionomer (GhGI) – after atraumatic restorative treatment (ART) approach	To evaluate the efficacy of ZrGI in reducing pain and sensitivity and clinical success compared to GhGI in molars with MIH, after ART.	ZrGI is as effective as GhGI in pain reduction. Both restorations showed satisfactory success rates but did not prevent enamel degradation
Inchingolo A. M. et al (2023)	Systematic Review	23 articles	Treatment options for MIH	To evaluate the different proposed treatments for MIH	Treatment should be according to severity, patient age, and other variables
Montaser A. G. et al (2023)	Randomized controlled clinical trial	68 patients (8 to 13 years old) with the severe form of MIH.	Ceramic restorations fabricated by CAD/CAM	To evaluate the clinical performance of ceramic restorations fabricated by CAD/CAM with different preparation designs	There was no statistically significant difference between the groups.
Al-Nerabieah Z. et al (2024)	Randomized controlled clinical trial	100 children with MHI	Silver diamine fluoride (SDF) and casein phosphopeptide-amorphous calcium phosphate fluoride varnish (CPP-ACPF)	Compare silver diamine fluoride (SDF) and casein phosphopeptide-amorphous calcium phosphate fluoride (CPP-ACPF) in the prevention of caries, enamel wear, and sensitivity in MIH	Silver diamine fluoride (SDF) showed greater efficacy in reducing and arresting caries compared to casein phosphopeptide-amorphous calcium phosphate fluoride (CPP-

Authors	Study design	Sample	Material/Technique evaluated	Outcomes analyzed	Results
					ACPF). Both treatments were equally effective in preventing enamel degradation and relieving sensitivity
Mistry N. S. et al (2024)	Systematic review and meta-analysis	11 articles	Aesthetic treatments for MIH	To analyze the effects of treatments on enamel color changes in teeth with MIH	Seven articles concluded that resin infiltration was the most effective treatment method
Ritto F. P et al (2023)	Systematic review	14 articles (Randomized controlled clinical trial)	Treatments for mild and severe MIH	Analyze the treatment patterns for mild and severe MIH	Mild MIH requires remineralization, desensitization, sealants, and careful follow-up. Severe MIH requires restoration to control hypersensitivity and to rebuild the affected teeth
Cavalcante B. G. N. et al (2024)	Systematic review and meta-analysis	15 articles	CPP-ACP and other non-invasive agents	To evaluate non-invasive strategies for remineralization and hypersensitivity treatment in MIH.	CPP-ACP is more effective in reducing hypersensitivity compared to fluoride, calcium glycerophosphate, and SDF, which showed moderate benefits in hypersensitivity management.

Source: Prepared by the authors.

4 DISCUSSION

Molar-incisor hypomineralization and Orofacial Clefts

Molar-incisor hypomineralization (MIH) has been described as a frequent condition in individuals with orofacial clefts, being considered one of the dental manifestations associated with these craniofacial anomalies (Koruyucu et al., 2018). The studies analyzed in this work reinforce the high prevalence of MIH in this population (Lacerda et al., 2023; Farias et al., 2025; Allam et al., 2018; Knaap-Kind et al., 2024; Bhatia et al., 2024) and point out significant differences regarding the type of cleft (Lacerda et al., 2023; Farias et al., 2025), the surgical interventions performed (Allam et al., 2018), and the location of the affected teeth (Allam et

al., 2018; Farias et al., 2025; Knaap-Kind et al., 2024). However, none of the reviewed studies addressed therapeutic strategies, clinical management, or rehabilitation specifically aimed at individuals with cleft lip and palate.

The study conducted by Lacerda et al. (2024) highlights an overall frequency of 67% of MIH in individuals with CLP, with notable variations according to phenotype. Patients with bilateral CLP showed the highest prevalence (77%), followed by individuals with unilateral CLP (approximately 60%), while those with isolated cleft palate showed the lowest frequency (25%). These findings suggest that the complexity of the cleft is directly related to both the frequency and the number of teeth affected by MIH.

It is important to emphasize that the individuals evaluated in the study by Lacerda et al. (2024) had not yet undergone ABG, which reinforces the hypothesis that this high prevalence results from pathogenic mechanisms shared between the development of the primary palate and enamel structural disorders, supporting the common multifactorial genetic origin for cleft lip and palate and MIH (Koruyucu et al., 2018). Such evidence corroborates the interpretation that the cleft does not constitute an isolated event but is part of a dental syndrome, a concept that aligns with the genetic findings presented by Koruyucu et al. (2018), which highlight the association between the HMCN1 gene and the presence of MIH, cleft lip and palate, and other dental anomalies such as agenesis and supernumerary teeth.

Notably, when evaluating the relationship between surgical procedures and demarcated hypomineralization, Farias et al. (2023) observed that patients who underwent palatoplasty or ABG had a lower chance of developing this defect, with no significant differences for other procedures. This result contrasts with the findings of Allam et al. (2018), who reported a higher prevalence of MIH in patients undergoing primary ABG, especially in incisors. This divergence can be explained by methodological differences between the studies, such as the broader definition of developmental defects of enamel (DDE) in the study by Farias et al. (2023) and the population-level analysis adopted, as opposed to the tooth-level focus in other studies. Additionally, variations in surgical protocols among treatment centers may also contribute to the observed discrepancies.

Complementing this perspective, Farias et al. (2025), in a tooth-level study, also found a statistically significant association between MIH and clefts involving the palate, both unilateral and bilateral. The permanent upper right molars were the most frequently affected teeth, indicating the need for clinical attention focused on the upper arch in patients with more complex clefts. These data reinforce that the increased anatomical complexity of the cleft can directly influence the number and location of affected teeth, complementing the findings of

Farias et al. (2023) on the relationship between the type of cleft and the manifestation of enamel defects.

Regarding surgical interventions, the study by Allam et al. (2018) further analyzed the relationship between ABG and the presence of MIH, comparing individuals with cleft who underwent primary ABG, secondary ABG, and a control group (without cleft). The results showed that both ABG groups had significantly higher prevalences of MIH compared to the control, with the primary ABG group showing greater involvement in the incisor region. These findings suggest that early intervention during the formative period of incisor enamel may compromise mineralization, acting as a local risk factor.

In addition to those studies, the findings of van der Knaap-Kind et al. (2025) reinforce the association between CLP and hypomineralization defects. In a sample of 516 patients, the authors found a prevalence of 12.8% for MIH—values significantly higher than those observed in the general population. Although the study did not identify an association with the type of cleft or the presence of syndromes, it demonstrated that the presence of hypomineralization in second primary molars increases almost threefold the likelihood that the patient will also present MIH. This suggests a common systemic etiological mechanism and highlights the importance of early monitoring.

Bhatia and Subramanian (2024) conducted a comparative analysis between patients with unilateral CLP and those without clefts, demonstrating that the former presented higher MIH scores in the first permanent molars and upper incisors on the cleft side. The results suggest a pattern of asymmetric involvement, with greater impairment on the cleft side, and reinforce the hypothesis that local changes related to craniofacial development and enamel formation may act in combination.

Studies have shown that MIH is more prevalent in individuals with complex orofacial clefts, particularly those involving the palate, and tends to be more severe in bilateral cases. Furthermore, factors such as the timing of surgical intervention, shared genetic factors, and cleft type appear to play an important role as risk factors for this condition. These findings highlight the importance of early and individualized dental follow-up, taking into account both the anatomical complexity of the cleft and the systemic and local risks for the development of hypomineralization.

Rehabilitation of Molar-Incisor Hypomineralization

Given the scarcity of publications relating MIH and CLP from the perspective of dental treatment, a second search was conducted, this time focused on the general population, with the aim of identifying evidence on MIH rehabilitation approaches. This broader scope made

it possible to gather relevant publications on therapeutic strategies applied in patients with MIH.

Although these protocols were not specifically developed for individuals with CLP, many of them show potential for adaptation to the clinical particularities of this group. It is important to note that the wide variability in the clinical presentation of MIH, combined with the sensitivity of affected teeth, represents a challenge for the standardization of clinical management, reinforcing the need for individualized treatment plans that take into account factors such as age, severity of lesions, and functional and aesthetic demands (Inchingolo et al., 2023).

In the prevention and preservation of dental integrity, silver diamine fluoride (SDF) demonstrated superior performance compared to casein phosphopeptide–amorphous calcium phosphate with fluoride (CPP-ACPF) in controlling caries (Al-Nerabieah et al., 2024). This effect is attributed to the formation of a silver–protein complex and a calcium fluoride layer, both providing antimicrobial and remineralizing action. However, both showed similar effectiveness in preventing enamel fractures and reducing sensitivity, reinforcing that CPP-ACPF is a viable alternative when the aesthetic impact of SDF—due to staining—is undesirable.

Mahfouz et al. (2025) evaluated Atraumatic Restorative Treatment (ART) using zirconia-reinforced glass ionomer cement (ZrGI) and hybrid glass ionomer cement (GhGI). This technique is particularly useful for anxious children with multiple affected teeth and hypersensitivity, as it allows the removal of only hypomineralized or decayed tissue while preserving sound structure. Although both materials showed similar clinical performance and contributed to reduced sensitivity, their durability may be compromised by technical limitations such as restricted access, insufficient lighting, and variability in operator skill.

Dentin hypersensitivity is one of the most challenging manifestations of MIH (Raposo et al., 2019; Linner et al., 2021), resulting from structural fragility and, in many cases, chronic pulpal inflammation (Fagrell et al., 2008). The systematic review by Cerqueira et al. (2025) showed that low-level laser therapy (LLLT) significantly reduces pain and sensitivity, either alone or combined with fluoride varnish and glass ionomer sealants. Nevertheless, the lack of standardization in clinical parameters—such as wavelength, power, and frequency of application—prevents the establishment of consistent guidelines. Similar results were observed by Cavalcante et al. (2024), who also noted that remineralizing agents such as CPP-ACP and calcium glycerophosphate are effective in severe cases, in which fluoride alone may be insufficient. However, the capacity of these compounds for deep remineralization remains uncertain, and further studies are needed for clinical validation.

In aesthetic management, resin infiltration has emerged as the most effective technique for masking superficial opacities associated with MIH (Mistry et al., 2024). Studies (Nefzaoui et al., 2025; Mistry et al., 2024) report significant improvement in lesion coloration, especially in shallower cases. However, the heterogeneity of protocols and the lack of methodological standardization make comparisons and universal recommendations difficult. For deeper lesions, Nefzaoui et al. (2025) advocate modified protocols involving prolonged acid etching, repeated applications, and the use of pretreatments that enhance resin penetration. Microabrasion is indicated for mild to moderate lesions, as it combines mechanical abrasion and chemical erosion, removing the hypomineralized layer and providing a smoother, more homogeneous surface. When combined with remineralizing agents, it improves mineral penetration into porosities and promotes more stable aesthetic and structural outcomes (Nefzaoui et al., 2025).

In restorative treatment, Montaser et al. (2023) evaluated CAD/CAM restorations made of zirconia-reinforced lithium silicate glass-ceramic and hybrid ceramic, in both occlusal veneer and endocrown designs, for first permanent molars affected by MIH. After 18 months, both techniques showed high success rates and no fractures, although marginal discoloration, plaque accumulation, and secondary caries were observed. None of the materials prevented the progressive degradation of enamel, indicating that restorative success depends on continuous monitoring and an associated preventive approach.

Ritto et al. (2023) synthesizes management strategies based on lesion severity: in mild cases, enamel preservation, hypersensitivity control, and caries prevention using remineralizing agents (fluoride, CPP-ACP, CPP-ACPF) are prioritized, combined with desensitizing agents such as arginine, calcium carbonate, or hydroxyapatite. The combination of laser therapy and fluoride varnish accelerates pain control, while resin-based or glass ionomer sealants, enhanced by fifth-generation adhesives, reduce caries risk. SDF, although effective, has aesthetic limitations. In moderate to severe cases, direct adhesive restorative techniques are still recommended for white-creamy defects without involvement of functional cusps. In extensive structural losses, onlays and full crowns—made of zirconia, lithium silicate, or metal—provide functional and aesthetic protection, while prefabricated stainless steel crowns can serve as a temporary solution for severely damaged teeth.

The studies reinforce that MIH management should be personalized, combining preventive measures, hypersensitivity control therapies, and restorations tailored to the extent of the defect and the patient's needs. Despite gathering relevant evidence, this study presents some limitations. Methodological heterogeneity among the included studies—particularly regarding MIH diagnostic criteria, sample characteristics, and therapeutic

approaches—hampers direct comparison of results and limits the generalizability of the findings.

Another aspect to be considered is that most available studies are observational, which weakens the evidence for establishing causal relationships between risk factors, prevalence, and clinical implications. Added to this is the scarcity of specific research on MIH in patients with CLP and the short clinical follow-up period of most studies, which reinforces the need for future investigations with greater methodological standardization, longitudinal evaluation, and patient-centered outcomes. Only then will it be possible to consolidate effective management strategies that balance function, aesthetics, and long-term results, providing comprehensive and effective care to children and adolescents with MIH.

5 CONCLUSION

It is concluded that molar-incisor hypomineralization has a significantly higher prevalence in patients with cleft lip and palate compared to individuals without cleft, especially in cases involving the palate and, more markedly, in bilateral clefts. The anatomical complexity of the cleft, the timing of surgical interventions — especially alveolar bone grafting — and genetic factors are important determinants for the development of MIH in this population.

The clinical implications of this condition go beyond the aesthetic impact, affecting masticatory function, dental sensitivity, and quality of life, especially in patients vulnerable due to the rehabilitative demands arising from the cleft. Management requires an individualized approach that integrates preventive strategies, hypersensitivity control, and restorations appropriate to the extent of the defect, balancing function, aesthetics, and durability.

REFERENCES

Allam, E., Ghoneima, A., Tholpady, S. S., & Kula, K. (2018). Enamel hypomineralization in children with clefts and the relationship to treatment: A cross-sectional retrospective study. Annals of Plastic Surgery, 81(5), 544–547. https://doi.org/10.1097/SAP.0000000000001538

Almulhim, B. M. (2021). Molar and incisor hypomineralization. JNMA: Journal of the Nepal Medical Association, 59(235), 295–302. https://doi.org/10.31729/jnma.6343

Al-Nerabieah, Z., Alkhouli, M., & Dashash, M. (2024). Preventive efficacy of 38% silver diamine fluoride and CPP-ACP fluoride varnish on molars affected by molar incisor hypomineralization in children: A randomized controlled trial. F1000Research, 12, Article 1052. https://doi.org/10.12688/f1000research.136653.3

Cavalcante, B. G. N., Mlinkó, É., Szabó, B., Teutsch, B., Hegyi, P., Vág, J., Németh, O., Gerber, G., & Varga, G. (2024). Non-invasive strategies for remineralization and hypersensitivity management in molar–incisor hypomineralization—A systematic review and meta-analysis. Journal of Clinical Medicine, 13(23), Article 7154. https://doi.org/10.3390/jcm13237154

Cerqueira, N. M., Altube, L. G., Gambarini, L., Borsatto, M. C., & Corona, S. A. M. (2025). Laser therapy in molar-incisor hypomineralization (MIH) teeth treatment of hypersensitivity: A systematic review. Lasers in Medical Science, 40(1), Article 11. https://doi.org/10.1007/s10103-024-04280-z

Crombie, F., Manton, D., & Kilpatrick, N. (2009). Aetiology of molar-incisor hypomineralization: A critical review. International Journal of Paediatric Dentistry, 19(2), 73–83. https://doi.org/10.1111/j.1365-263X.2008.00966.x

de Farias, A. L., Rojas-Gualdrón, D. F., Restrepo, M., Zecchin, K. G., Bussaneli, D. G., Yupanqui, K., Raposo-Amaral, C. E., & Santos-Pinto, L. (2025). Characterization of hypomineralization second primary molar and molar incisor hypomineralization in patients with orofacial clefts. Clinical Oral Investigations, 29(5), Article 269. https://doi.org/10.1007/s00784-025-06311-7

Dixon, D. A. (1968). Defects of structure and formation of the teeth in persons with cleft palate and the effect of reparative surgery on the dental tissues. Oral Surgery, Oral Medicine, Oral Pathology, 25(3), 435–446. https://doi.org/10.1016/0030-4220(68)90019-4

Dixon, M. J., Marazita, M. L., Beaty, T. H., & Murray, J. C. (2011). Cleft lip and palate: Understanding genetic and environmental influences. Nature Reviews Genetics, 12(3), 167–178. https://doi.org/10.1038/nrg2933

Fagrell, T. G., Lingström, P., Olsson, S., Steiniger, F., & Norén, J. G. (2008). Bacterial invasion of dentinal tubules beneath apparently intact but hypomineralized enamel in molar teeth with molar-incisor hypomineralization. International Journal of Paediatric Dentistry, 18(5), 333–340. https://doi.org/10.1111/j.1365-263X.2007.00908.x

Farias, A., Rojas-Gualdrón, D. F., Restrepo, M., Zecchin, K. G., Bussaneli, D. G., Yupanqui, K., Raposo-Amaral, C. E., & dos Santos-Pinto, L. (2023). Characterization of enamel developmental defects in patients with orofacial clefts and their relationship to surgical procedures. Clinical Oral Investigations, 27(12), 7809–7820. https://doi.org/10.1007/s00784-023-05370-y

Freitas, J. A., das Neves, L. T., de Almeida, A. L., Garib, D. G., Trindade-Suedam, I. K., Yaedú, R. Y., Lauris, R. C., Soares, S., Oliveira, T. M., & Pinto, J. H. N. (2012). Rehabilitative treatment of cleft lip and palate: Experience of the Hospital for Rehabilitation of Craniofacial Anomalies/USP (HRAC/USP) – Part 1: Overall aspects. Journal of Applied Oral Science, 20(1), 9–15. https://doi.org/10.1590/s1678-77572012000100003

Inchingolo, A. M., Inchingolo, A. D., Viapiano, F., Ciocia, A. M., Ferrara, I., Netti, A., Dipalma, G., Palermo, A., & Inchingolo, F. (2023). Treatment approaches to molar incisor hypomineralization: A systematic review. Journal of Clinical Medicine, 12(22), Article 7194. https://doi.org/10.3390/jcm12227194

Koruyucu, M., Kasımoğlu, Y., Seymen, F., Bayram, M., Patır, A., Ergöz, N., Tuna, E. B., Gencay, K., Deeley, K., Bussaneli, D., Modesto, A., & Vieira, A. R. (2018). Rethinking isolated cleft lip and palate as a syndrome. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, 125(4), 307–312. https://doi.org/10.1016/j.oooo.2018.01.007

Linner, T., Khazaei, Y., Bücher, K., Pfisterer, J., Hickel, R., & Kühnisch, J. (2021). Hypersensitivity in teeth affected by molar-incisor hypomineralization (MIH). Scientific Reports, 11(1), Article 17922. https://doi.org/10.1038/s41598-021-95875-x

Maciel, S. P., Costa, B., & Gomide, M. R. (2005). Difference in the prevalence of enamel alterations affecting central incisors of children with complete unilateral cleft lip and palate. The Cleft Palate-Craniofacial Journal, 42(4), 392–395. https://doi.org/10.1597/02-152.1

Mahfouz, R. A., Hanno, A. G., & Rahman, A. M. A. E. (2025). Zirconia-reinforced glass ionomer restorations in molar incisor hypomineralization: A randomized controlled clinical trial. Clinical Oral Investigations, 29(6), Article 290. https://doi.org/10.1007/s00784-025-06352-y

Mistry, S. N., & Muwaquet Rodriguez, S. (2024). Comparison of aesthetic treatments for molar-incisor hypomineralisation: Systematic review and meta-analysis. The Saudi Dental Journal, 36(2), 222–227. https://doi.org/10.1016/j.sdentj.2023.11.004

Montaser, A. G., Hashem, S.Hashem, S. N., Ali, M.-A. S., Fathy, N. A., Safwat, H. A., & Eldehna, A. M. (2023). Clinical performance of two CAD/CAM fabricated ceramic restorations with different designs for MIH rehabilitation: A randomized controlled trial. The Open Dentistry Journal, 17, Article e18742106268968. https://doi.org/10.2174/0118742106268968231101065907

Nefzaoui, M., Chalbi, M., & Chemli, M. A. (2025). How to make incisor opacities disappear in children and adolescents with molar incisor hypomineralization? A systematic review. Journal of Esthetic and Restorative Dentistry, 37(9), 2072–2082. https://doi.org/10.1111/jerd.13488

Raposo, F., Rodrigues, A. C. de C., Lia, É. N., & Leal, S. C. (2019). Prevalence of hypersensitivity in teeth affected by molar-incisor hypomineralization (MIH). Caries Research, 53(4), 424–430. https://doi.org/10.1159/000495848

Ritto, F. P., Tiwana, K. R., Schmitz, T. A., Dacus, Z. L., Borges, M. A. P., & Canellas, J. V. (2023). A qualitative analysis of treatment patterns for mild and severe molar hypomineralization in permanent teeth: A systematic review. Pediatric Dentistry, 45(4), 281–291.

Schwendicke, F., Elhennawy, K., Reda, S., Bekes, K., Manton, D. J., & Krois, J. (2018). Global burden of molar incisor hypomineralization. Journal of Dentistry, 68, 10–18. https://doi.org/10.1016/j.jdent.2017.12.002 (Erratum in: Journal of Dentistry, 80, 89–92. https://doi.org/10.1016/j.jdent.2018.12.002)

Veras, R. O., Sá Junior, S. C., Silva, A. A., & Agostinho, C. N. L. F. (2021). Atenção ao tratamento do paciente com fissura lábio-palatina: Revisão de literatura. Brazilian Journal of Surgery and Clinical Research, 36(3), 38–43.

Wanderley Lacerda, R. H., Filgueiras, V. M., Guedes Mendonça, A. C., & Vieira, A. R. (2024). Molar-incisor hypomineralization in a cohort of individuals born with cleft lip and palate. Orthodontics & Craniofacial Research, 27(Suppl. 1), 21–26. https://doi.org/10.1111/ocr.12708

Weerheijm, K. L. (2003). Molar incisor hypomineralisation (MIH). European Journal of Paediatric Dentistry, 4(3), 114–120.