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Management of MIH-Affected Tooth Using a CAD/CAM Hybrid Composite Inlay: A Case Report

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Abstract

Molar–incisor hypomineralization (MIH) is a developmental enamel defect affecting at least one first permanent molar and often the incisors, presenting as asymmetrical, well-demarcated opacities ranging from mild discoloration to extensive post-eruptive breakdown. Affected teeth show reduced mineralization, increased sensitivity, and higher susceptibility to caries, fractures, and atypical wear. The etiology is multifactorial, involving systemic, genetic, environmental, and epigenetic factors, with environmental influences occurring during early tooth development.

This case report describes a 9-year-old healthy girl with MIH-affected first permanent molars and anterior teeth, presenting with hypersensitivity and recurrent restoration failures. Tooth 26 exhibited moderate structural loss and incomplete root development. A minimally invasive restoration protocol was implemented, including removal of defective material, cavity preparation, isolation, impression taking, and fabrication of a CAD–CAM ceramic inlay, cemented using adhesive techniques with occlusal adjustment.

At 12-month follow-up, the inlay demonstrated preserved integrity, maintenance of surrounding tooth structure, and positive pulp vitality. This case highlights the effectiveness of a conservative CAD–CAM inlay approach in MIH-affected molars, emphasizing the importance of early diagnosis, careful treatment planning, and adherence to adhesive protocols to achieve long-term functional and aesthetic outcomes.

Keywords: MIH, CAD-CAM technique, inlay restoration

Background

Molar–incisor hypomineralization (MIH) is a term describing hypomineralization defects in the enamel of at least one of the four first permanent molars and usually, though not necessarily, involving the permanent incisors as well (1). The hypomineralization defects range from small, well-demarcated areas of altered color on the clinical crown to involvement of the entire crown with normal enamel thickness (2). The defects are asymmetrically distributed and have clearly defined borders (1, 3).

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The diagnosis of MIH depends on the clinical evaluation of qualitative enamel defects and can be classified as mild, moderate, or severe. Its severity varies widely—from distinct isolated white, yellow, or brown opacities to severe post-eruptive breakdown (PEB) of the dental structure. Qualitative enamel defects are associated with reduced mineralization and increased protein and water content, leading to discoloration and heightened sensitivity. Affected teeth are more susceptible to the development of carious lesions, lesions in atypical locations, fractures, and increased wear (4, 5). In patients with MIH, the risk of developing carious lesions is 4.6 times higher (6). Enamel breakdown is more frequently observed in molars and is associated with functional masticatory forces (7). Increased pulpal involvement is linked to the rapid bacterial invasion through the porous hypomineralized enamel; such complications are more common in extensive defects occurring shortly after tooth eruption (8, 9, 10).

The etiology of MIH is considered complex, involving systemic, genetic, environmental, and epigenetic factors. Environmental factors associated with MIH-related alterations exert their influence during early tooth development, including the prenatal period (10–15). Several indices for MIH have been described in the literature. The earliest severity index has been used to characterize the condition of hypomineralized first permanent molars. Molar defects are classified as mild—limited changes in enamel translucency; moderate—visible enamel loss; and severe—enamel loss with dentin involvement or atypical restorations (16). The modified Developmental Defects of Enamel (DDE) Index was proposed by the FDI World Dental Federation in 1992 and includes all types of enamel defects, including qualitative (demarcated opacities, diffuse opacities) and quantitative (hypoplasia) alterations (17). Another MIH index employs two objective criteria—the degree of hypomineralization and the number of placed/replaced restorations—and one subjective criterion—dental sensitivity (18).

Awareness of the condition and early diagnosis are essential for prevention or timely restorative intervention aimed at avoiding the development of carious lesions, pulpal involvement, hypersensitivity, and addressing aesthetic concerns (19–21). Preventive measures include identifying risk factors, optimizing oral hygiene, controlling dietary habits, managing increased sensitivity, promoting remineralization, and discussing treatment protocols at the earliest stages of alteration (20, 22). Authors report that MIH-affected teeth with heightened sensitivity are difficult to anesthetize, which complicates restorative treatment and contributes to anxiety and fear in patients (23–25).

The restorative protocols follow the principles of minimally invasive treatment methods. Options for managing compromised incisor aesthetics include microabrasion, bleaching, resin infiltration, direct/indirect composite restorations, and veneers (19). To improve micro-adhesion to the affected enamel, the removal of 1.5 mm of enamel and placement of the restorative material on unaffected areas is recommended, as well as the use of adhesive stabilization with a dentin bonding agent (26, 27). Long-term restorative solutions include onlays, overlays, indirect ceramic restorations (CAD–CAM), and crowns (28).

Aim

The aim of the present study is to demonstrate the restoration protocol of a tooth diagnosed with MIH through the placement of an inlay.

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Case report

A 9-year-old systemically healthy girl was referred for examination with complaints of increased sensitivity in the distal regions. The sensitivity was provoked and manifested during oral hygiene procedures and the consumption of cold foods and beverages. The patient reported that the most severe symptoms occurred in the upper left region. The child had previously visited a dentist multiple times for this complaint, during which restorations were placed but periodically detached or fractured.

Fig. 1. Initial intraoral status

Upon examination, compromised aesthetics were noted in the anterior teeth, and the first permanent molars were affected with moderate structural loss—defective restorations exposing

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soft yellow-brown dentin were observed. Based on the medical history, a treatment protocol was devised to begin with the area of most severe symptoms, specifically the first permanent molar (tooth 26) (Fig. 1).

The vitality of the tooth was assessed using an electric pulp test (Scorpion, 405-7A, Optica Laser, Bulgaria), which showed a positive response – 22 microamperes (μA). Segmental radiography revealed no communication with the pulp chamber, and the tooth exhibited incomplete root development (Fig. 2).

Fig. 2. Radiograph of tooth 26

In view of the treatment performed to date and the materials used (GIC, light-cured composite materials) and their outcomes, it was decided that the restoration would be carried out using an inlay fabricated with a CAD–CAM system. The milled material used for the fabrication of the inlay was the hybrid composite VITA ENAMIC (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Germany).

Treatment Protocol:

1. Anesthesia: Considering the increased sensitivity and difficulties in anesthetizing teeth diagnosed with MIH, a local anesthesia was administered using Dentocaine (Septodont, Saint-Maur-des-Fossés, France).
2. Preparation: Removal of defective portions of the GIC restoration and irreversibly damaged tooth structures. Cavities were shaped with smooth transitions (Fig. 3A).
3. Isolation: Cotton rolls and a saliva ejector were used.
4. Lining Placement: GIC was applied to provide isolation and to level uneven surfaces at the cavity floor.
5. Impression Taking: A two-step, double-layer impression was made using C Silicone (Zetaplus Putty, Zhermack, Badia Polesine, Italy) (Fig. 3B).
6. Temporary Restoration Placement.

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Fig. 3. A. Tooth preparation; B. Double-layer impression

Cementation procedure

Tooth Preparation Protocol:

1. Etching: 37% orthophosphoric acid was applied for 20 seconds on enamel-preserved areas and 15 seconds on dentin.
2. Rinsing and Drying: The tooth was rinsed with water for 30 seconds and gently dry for 5–10 seconds.
3. Adhesive Application: The adhesive material was applied G-Premio Bond (GC, Tokyo, Japan) for 10 seconds.
4. Light Curing: The adhesive material was polymerized for 10–20 seconds.

Inlay Preparation Protocol (Fig. 4):

1. Hydrofluoric Acid Treatment: 5% hydrofluoric acid was applied for 20 seconds.
2. Rinsing and Drying: The inlay was rinsed for 30 seconds and dry for 5 seconds.
3. Etching: Orthophosphoric acid was applied to remove residues from the hydrofluoric acid etching for 20 seconds.
4. Rinsing, Cleaning, and Drying: The restoration was rinsed, cleaned with alcohol, and dried thoroughly.
5. Silane Application: Silane was applied for 60 seconds.
6. Bond Application: Bonding agent was applied for 20 seconds without light curing.
7. Cement Application: GIC cement FUJI One (GC, Tokyo, Japan) was applied to the inlay and seat it onto the tooth.
8. Simultaneous Light Curing of adhesive and Cement: Light cure for 2–3 seconds and remove excess material.
9. Final Light Curing: The surface cured for 40 seconds.

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Fig. 4. Final inlay restoration

After the contacts were established, the occlusion was checked and adjusted (Fig. 5). The restoration was polished. A 12-month follow-up was performed, revealing preserved integrity of the restoration and maintenance of the surrounding tooth structure. Pulp vitality testing yielded positive results with value 15 microamperes (μA).

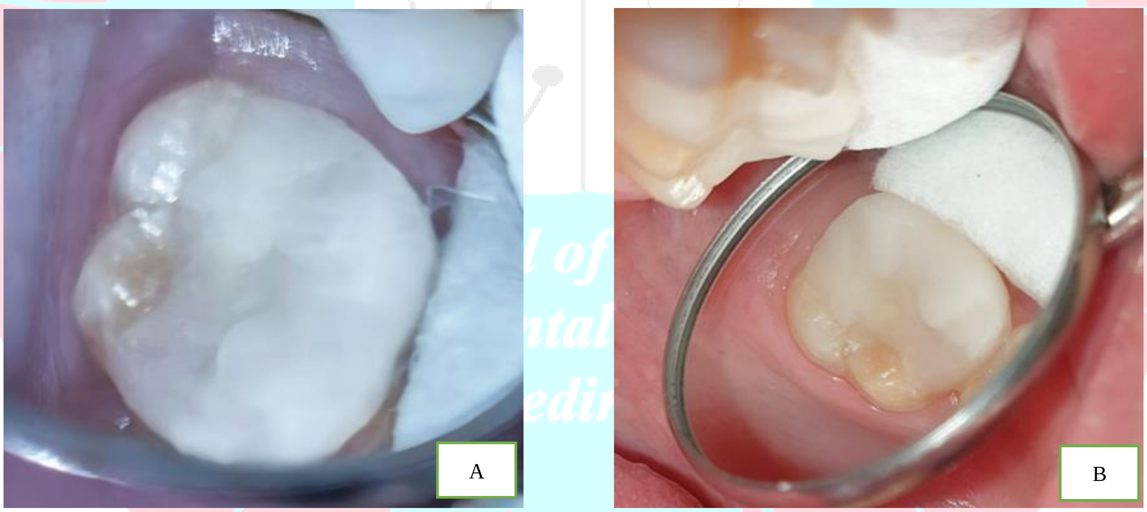

Fig. 5. Cemented inlay

A. After the cementation; B. 12 – months post-cementation

Discussion

Children with MIH show an increased risk of dental caries, requiring more frequent and intensive dental interventions. Therefore, early implementation of preventive strategies is essential as soon as lesions appear in the erupting first permanent molars. Fissure sealants are recommended in mild cases of MIH, in which there is no post-eruptive breakdown but hypersensitivity to stimuli such as air and water is observed (29).

Composite resins remain widely studied, with survival rates ranging from 59% to 96%. They are recommended for the long-term restoration of fully erupted molars affected by MIH (30). Severely

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affected hypomineralized teeth often require full-coverage crowns due to wear of the cavosurface margin. Stainless steel crowns (SSC) remain the most common option in children due to their strength, ease of placement, affordability, and immediate relief of hypersensitivity, although they are considered temporary solutions (31) A 24-month comparative study by De Farias et al. showed that SSCs had significantly higher survival rates than composite crowns (CRs) in first permanent molars affected by MIH. Both techniques use minimally invasive approaches, although debate continues as to whether complete removal of hypomineralized enamel is necessary to ensure strong adhesion. SSCs remain a feasible temporary solution for severe cases, although more evidence is needed to fully determine their therapeutic value (30, 32).

Singh et al. evaluated zirconia, lithium disilicate, and cast metal crowns for full-coverage restoration of MIH-affected first permanent molars and found comparable clinical performance over 24 months. These materials may also be suitable for managing enamel defects arising from amelogenesis imperfecta, hypoplasia, or fluorosis. Full metal crowns (FMCs) are still considered the gold standard due to their superior mechanical properties and durability (31).

Pediatric dentists often encounter challenges when managing young patients presenting with first permanent molars affected by moderate MIH, primarily due to the fragility of these teeth, the presence of carious lesions on one or two surfaces, and their heightened sensitivity (33). Traditionally, stainless steel crowns were employed for restoring molars. However, the demand for improved esthetics and the early age of the patient population have prompted the search for more conservative and visually acceptable restorative alternatives (34). In this context, overlay restorations have been proposed as substitutes for full-coverage crowns to preserve tooth structure while reducing the risk of fracture, aligning with the principles of minimally invasive dentistry (35). Currently, indirect aesthetic restorations benefit from CAD/CAM technology, which minimizes technique sensitivity, reduces clinical time, and provides restorations with greater material homogeneity and fewer defects (36-38). Monolithic zirconia restorations offer satisfactory aesthetic results combined with excellent mechanical properties and biocompatibility, demonstrating promising clinical outcomes (39). However, the inherent difficulties associated with bonding to zirconia have contributed to the growing popularity of IPS e.max CAD, which provides improved adhesive potential, along with favorable aesthetics and high strength (40).

Restorations with CAD-CAM technology adhere to biomimetic principles, offering minimally invasive solutions with adequate mechanical durability. The results of this search showed excellent targeted mechanical durability over time. No chipping of the restoration or loss of bond to the tooth structures was observed. Regarding the aesthetic parameters, no changes from baseline were observed at the 12-month evaluation in either surface gloss or anatomy. This result can be explained by the ability of the overlay restorations to achieve satisfactory aesthetics after appropriate polishing and glazing procedures, which help to reproduce the natural gloss of the tooth surface. The gradual decrease in gloss over time is partly related to the natural changes in tooth color and translucency (41).

Montaser et al. conducted a randomized clinical trial assessing two CAD/CAM restorations—occlusal veneers and endocrowns—for MIH-affected molars. Both lithium silicate–zirconia–reinforced ceramics and hybrid ceramics demonstrated reliable performance over 18 months to 3 years (42, 43). Occlusal veneers and endocrowns align with minimally invasive principles, avoiding

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excessive axial reduction and allowing treatment of severely compromised teeth with insufficient coronal structure (43).

Conclusion

The present case demonstrates that the fabrication of an inlay from a hybrid composite using CAD/CAM technology is a suitable option for restoring teeth diagnosed with MIH. This type of restoration is particularly appropriate for children, as it does not require prolonged mouth opening during individual appointments and meets both mechanical and aesthetic requirements.

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