Objective: This article describes the esthetic results in a paradigmatic case of hypomineralized enamel correction on both anterior and posterior teeth to establish a minimal intervention protocol for similar cases. Clinical considerations: The subject was initially provided with casein-calcium-phosphate mineral supplementation. Unpublished laboratory images collected as part of a previously published study depict the results of initial calcium-phosphate supplementation on molar incisor hypomineralization (MIH) molar enamel morphology and indicate that this procedure is mandatory in moderate/severe cases. Prior to defect restoration, in-office bleaching of the anterior segment was conducted with bioactivated Opalescence Boost. Filtek Supreme Ultra Universal Restorative was used as a masking agent, and Filtek A2 enamel was applied as the final layer. Conclusion: An 8-year follow-up period is necessary in most moderate/severe MIH cases involving orthodontics and bleaching.

Key words: MIH diagnosis, MIH supplementation, MIH treatment, molar incisor hypomineralization (MIH), orthodontic treatment, restorative treatment

This article describes the esthetic results in a paradigmatic case of hypomineralized enamel correction on both anterior and posterior teeth to establish a minimal intervention protocol for similar cases.

The severity of the case described was diagnosed in accordance with the molar incisor hypomineralization (MIH) classification provided by Oliver et al\(^1\) and Chawla et al\(^2\) using the new Molar Hypomineralization Severity Index (MHSI)\(^1,2\) based on defects, color, location, post-eruptive breakdown (PEB), restorations placed/replaced, and atypical sensitivity. These characteristics can be useful to predict treatment efficacy in affected first permanent molars and may guide clinical management.

Reduced mineral content of the MIH enamel is frequently associated with increased organic content.\(^3\) Treatment of enamel with high organic content using bonding technologies can be problematic, as the organic material in the enamel frequently prevents effective etching. Retention of enamel matrix proteins or uptake of organic material into hypomineralized enamel can cause enamel discoloration, often resulting in a yellow-brown appearance. Since 2011, this has been the rationale for calcium-phosphate supplementation.

The provision of fluoride ions in mineralizing media during the development of biogenic apatites increases the crystal growth rate by augmenting precipitation. The inclusion of fluoride in casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) supplements represents a breakthrough in treatment effectiveness and speed of hypomineralized areas.\(^4\)

Only a few small studies, mainly concerning high-risk caries/abrasion, have investigated treatment options for MIH enamel.\(^5\) Application of fissure sealants or remineralization appear suitable for treatment of MIH molars with limited severity and/or hypersensitivity.\(^6\) More severe cases may require restorations, including direct/indirect resin restorations or preformed metal crowns. Currently, there are no clear recommendations regarding MIH incisors.
SEM method and materials

Scanning electron microscopy (SEM) micrographs depicting MIH molar enamel specimens collected for the study published in 2011 are shown. Fragments of MIH molars were fixed in 4% glutaraldehyde, 0.2 mol/L sodium cacodylate buffer solution for 48 hours, dehydrated through a graded alcohol series, and sputter coated with gold–palladium (Sputter Coater SC7620, Polaron) for SEM (JSM-5200, JEOL) for analysis at various magnifications.

SEM results and discussion

Figures 1a and 1b depict SEM magnifications of non-supplemented and supplemented MIH enamel; Figs 1c and 1d shows samples of fragments from the same series as reported by Baroni and Marchionni with different images.

At the beginning of treatment, crystals showed loose and irregular packing with a “snowy forest” appearance and were immersed in a low-density substance. The enamel prisms were

**Figs 1a to 1d**  
Beginning of treatment: (a) 5,000× and (b) 20,000× magnifications. Crystals seem to be loose as if they were ready to break away from each other. There is protrusion of pointed prisms from a layer with no established framework. End of treatment: (c) 5,000× and (d) 20,000× magnifications. Crystal elongation along the c-axis is initiated by deposition of small protrusions on the basal plane. Prism morphology is shown to evolve into an almost hexagonal shape.

**Fig 2** Anterior view of 7-year-old patient before supplement treatment.

**Fig 3** Maxillary right molar before supplement treatment.
covered with an amorphous layer, from which irregular prisms protruded. The isolated prisms were rock-shaped.

At the end of treatment, SEM at 20,000× magnification showed that the rod structure had evolved into a more mature and mineralized tissue, almost geometric in shape, but it was smaller than normal. Deposition of small protrusions on the basal plane initiated crystal elongation along the c-axis.

The increased mineralization may result from decreased calcium content and increased calcium and phosphate content.

This study also examined the influence of chemical content on the morphology of MIH enamel prisms.

**Case report**

The case of a 7-year-old girl is presented from among a group of children diagnosed with MIH participating in the aforementioned study (Fig 2). Initial treatment was no-fluoride Recaldent, GC Tooth Mousse (GC Corporation), which was the only product available at the time.

Subsequently, an improved GC Toothpaste with fluoride (TM PLUS, GC Europe; 10% CPP-ACP with 0.2% NaF) was used for 2 years during the eruption of permanent teeth.

The photographs of molars and incisors illustrate the initial situation before supplementation (Figs 2 and 3). Clinically, the mandibular left first molar was restored with a composite resin cusp covering (Clearfil Majesty A2, Kuraray) and was not re-treated (Fig 3).

Unaffected molars were sealed over time during full arch eruption (Clinpro, 3M Espe). Orthodontic treatment for Class 2 malocclusion lasted 3 years (Fig 4). After continuous follow-up for 8 years following diagnosis, a two-visit bleaching protocol was applied in the anterior region, which showed moderate severity, using Opalescence Boost (Ultradent Products) bioactivated for 20 minutes with a diode laser 840 (Pocket Laser, Orotig Med).

Esthetic restoration of the maxillary left incisor involved slight ameloplasty of abraded and discolored white-yellow defects using red band, rugby ball-shaped finishing burs (Intensiv SA, Montagnola) to create a bevel.
Filtek Supreme Ultra Universal Restorative (color A2 body, 3M Espe) was used as a masking agent, and Filtek A2 enamel (3M Espe) was applied as the final layer (Figs 5 to 8).

Final cuspal and occlusal covering of the worn and stained maxillary right molar was performed with both flowable (Filtek XTE Supreme Ultra Flowable Restorative, color A2, 3M Espe) and brushed nanofilled composites (Filtek Supreme Ultra Universal Restorative A2) as the final step (Figs 9 and 10).

All restorations were polished using Sof-Lex Extra-Thin Contouring and Polishing Discs (3M Espe) and rubber cups (Eve).

**Discussion**

White-yellow discoloration of the enamel in esthetically visible areas is clinically undesirable. Minimally invasive approaches to minimize the discoloration include the resin infiltration technique.7,8 However, there is no strong evidence for clinical recommendation of this technique, and further randomized controlled trials (RCTs) with long-term follow-up are required.9–11

As it is neither fully transparent nor fully opaque, the optical characteristics of tooth enamel cannot be reproduced easily.10 Alternative approaches for correcting discoloration of the
enamel include micro-abrasion, esthetic conservative restorations, and dental whitening for the incisors.12,13

In the present case, a delayed but stable approach was applied, which fulfilled both restorative and orthodontic needs, matching the tooth’s polychromatic characteristics and thereby potentially improving self-confidence in adolescence, as suggested by Wright.14 Occlusal morphology could not be reestablished, as it was in the other unaffected molars, due to additional wear produced by Class 2 molar correction.

The outcome of restoration of the maxillary right molar was imperfect, as it showed islands of deteriorated, worn-off enamel, and some exposed heavily pigmented dentin; also, the occlusal plane was altered by the orthodontic treatment.

The use of a flow composite to build up the palatal wall to achieve better polishing influenced the esthetic results, suggesting that a thicker layer of very clear micro-filled or liquid masking agent should have been employed to occlusally cover the flow.

Conclusions
Calcium-phosphate supplementation of MIH defects may improve etching and bonding efficacy in PEB molar restorations. Bleaching effectively reduced the area of white-yellow incisor defects before final restoration.

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