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Comparison of different treatment modalities in hypomineralized primary teeth: An original research

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***Abstract*---**Aim: The purpose of the present research was to evaluate various modalities for treating hypomineralized primary teeth. Methodology: Survival data retrospectively collected from 52 children with MIH, monitored. We evaluated one hundred and twenty unknown, high-quality photographs from occlusal and smooth surfaces, respectively, for the detection of cavitated carious lesions and caries-associated restorations (DMF index) and MIH. Descriptive and explorative analyses were performed, including Kaplan-Meier estimators. Results: The mean patient observation time was 42.9

months (SD = 35.1). The cumulative survival probabilities after 36 months—7.0% (GIC, N = 28), 29.9% (non-invasive composite restoration, N = 126), 76.2% (conventional composite restoration, N = 27) and 100.0% (ceramic restoration, N = 23)—differed significantly in the regression analysis. Conclusion: Conventional restorations were associated with moderate-to-high survival rates in MIH teeth.

***Keywords*---**disturbances in dental development, molar-incisor hypomineralization, restorative dentistry.

Introduction

The clinical management of developmental defects of enamel (DDEs) is a challenge to dental professionals worldwide. For example, enamel hypoplasia may facilitate the caries process, as a result of greater plaque accumulation on their surfaces.[1,2] In addition hypomineralization may cause rapid coronal destruction by mechanical forces, due to the structural weakness of the affected enamel.[3-6] Among the DDEs, the scientific literature has pointed out "Molar Incisor Hypomineralization" (MIH), as a result of its high prevalence in the child population, severe clinical consequences for affected children, in addition to the difficulty professionals find with its treatment.[6-8] It is a fact that children with MIH present more frequent and more complex dental treatment needs when compared with those who have normal tooth enamel.[9-11] As it is more porous and less resistant [12], the hypomineralized enamel facilitates the entry of bacteria into the subjacent dentin [13], resulting in a constant state of pulp inflammation [14] which causes discomfort on mechanical manipulation of the affected tooth. In some more severe cases, this hypersensitivity may also make it difficult to achieve efficient dental anesthesia, contributing to an increase in anxiety in children when they are faced with the prospect of dental treatment. Moreover, when present in incisors, these defects may cause the affected children psychological and social harm.[15] Many laboratory studies have demonstrated that in addition to greater porosity, hypomineralized enamel has less mineral density, thinner and more irregular prisms, and lower mechanical resistance. All these characteristics added to masticatory force contribute to post-eruptive structural losses being common in teeth affected by Molar Incisor Hypomineralization (MIH).[16,17] This appears to be the main fact responsible for the difficulty in obtaining satisfactory results in the restoration of affected teeth.[18] With regard to the restorative material, the professional should prefer adhesive materials to amalgam, because of its poor performance in the restoration of teeth with MIH.[10] The use of GIC is recommended, particularly as an inter-mediate restoration in a tooth still at the stage of eruption, and which may remain as a future base for adhesive restorations. Whereas, metal crowns must be applied to teeth in which there is not sufficient dental structure to support a conventional restoration.[6] The extraction of teeth with MIH and orthodontic follow-up may be a feasible alternative when the tooth is severely affected. Some authors have demonstrated that the extraction of affected molars in the correct period would not cause serious occlusal problems, and in some cases, would be the best alternative.[19,20] The use of other sources of fluoride, such as the application of concentrated fluoridated varnishes, may help with the mineralization process and reinforce the

tooth structure, particularly in recently-erupted teeth, which are more susceptible to caries and structural losses.[3] Another product that has been tested is calcium-phosphate casein, which has been shown to be effective, not only in the remineralization of the deeper layers of white spot caries, but also in increasing the phosphorous and calcium levels in MIH, which contributed to structural reinforcement and reduction in dentinal sensitivity.[21] These treatment modalities must be preferred instead of the use of more invasive measures, such as crown restorations or extractions. Therefore, this retrospective cohort study aimed, to investigate applied operative treatment options in children and adolescents exhibiting hypomineralized-related hard tissue breakdowns.

Aim of the present study

The purpose of the present research was to evaluate various modalities for treating hypomineralized primary teeth.

Methodlogy

This retrospective cohort study was conducted in adherence to the Declaration of Helsinki. The reporting followed the STROBE guidelines for observational studies. The present study finally comprised 52 individuals who were treated at our institution who had molar incisor hypomineralization (MIH). The plaque index was assessed by a visual and tactile examination of each tooth after air drying and judging the presence of plaque as 'yes' or 'no'. Caries status was determined using the dmf/DMF index in the primary and permanent dentition. In the patients included in the study, two non-invasive and two definitive conventional treatment strategies. Patients with less sufficient cooperation and small- to medium-sized defects received non-invasive restorations, either with GIC or with an adhesive bonding agent and composite material. Each restoration was rated exclusively as clinically sufficient/satisfactory or better was scored as 'sufficient', and if a restoration was judged clinically unsatisfactory or worse, it was rated as 'insufficient'. We evaluated one hundred and twenty unknown, high-quality photographs from occlusal and smooth surfaces, respectively, for the detection of cavitated carious lesions and caries-associated restorations (DMF index) and MIH. The inter- and intra-examiner kappa values of the examiner were found to be higher than 0.80 in all cases. An electronic case report form was designed to allow structured data entry of relevant information about patient characteristics, caries and MIH status as well as MIH-related restorations. The significance level was set at $\alpha = 0.05$, with a 95% confidence interval. Kaplan-Meier estimators were conducted to generate survival curves, survival probability, and median survival time.

Results

The mean age of the study population (N = 52; 26 females/ 26 males) was 11.2 years (SD = 2.9, min = 6.6, max = 18.2) at the time point of clinical evaluation, and the included individuals were monitored for a mean of 42.9 months (SD = 35.1). In the study group, 204 MIH-related restorations (posterior teeth = 184/ anterior teeth = 20) were placed, consisting of 28 (13.7%) GIC restorations, 126 (61.8%) non-invasive composite restorations, 27 (13.2%) conventional composite restorations, and 23 (11.3%) CAD/CAM-fabricated ceramic restorations. (Table 1)

When comparing the survival data descriptively and exploratively, it was found that both non-invasive treatment procedures showed the highest failure rates in comparison with conventional restorations. Kaplan-Meier curves revealed that the cumulative survival probability after 36 months was highest in the CAD/ CAM group (100.0%), followed by conventional composite (76.2%) and non-invasive composite restorations (29.9%) and lowest in GIC restorations (7.0%). Using the log-rank test, the four restorative procedures ($P < .001$), local anaesthesia ($P < .05$), and the type of treatment ($P < .05$) presented a significant effect on the survival. (Table 2)

Discussion

Molar incisor hypomineralisation (MIH) is a well-recognised qualitative dental defect that involves demarcated enamel, hypomineralisation of one to four first permanent molars (FPM) and is frequently associated with similarly affected permanent incisors.[6] MIH is associated with hypersensitivity, difficulty gaining adequate anaesthesia, atypical carious lesions, post-eruptive breakdown (PEB), a reduction in resin bond strength, aesthetic concerns and a reduction in quality of life. It has been suggested that the presence of hypomineralised second primary molars (HSPM) is a predictive sign for MIH.[18] This retrospectively designed cohort study analysed different non-invasive and conventional restorative procedures, which were mostly used in children severely affected by MIH. GIC restorations, which were predominately placed in posterior teeth of less cooperative patients, without cavity preparation, had the lowest cumulative survival probability. This finding is supported by previous studies indicating that GIC can be easily and non-invasively applied but shows a high likelihood to fail in stress-bearing areas of FPMs and should, therefore, only be considered as an intermediate approach. Contrary to this Fragelli et al16 showed that the likelihood of a restored tooth remaining unchanged at the end of 12 months was 78%, but restorations in this trial were placed under absolute isolation, which may probably enhance the longevity and is, furthermore, an indicator for the good cooperation of the 6- to 9-year-old patients. Preparation and removal of unstable hypomineralized enamel, the present study registered a high cumulative survival probability, which is comparable to previously published data. 19,20,38 Nevertheless, its practice-based design could help paediatric dentists, who are involved in the dental care of MIH patients, to identify adequate treatment procedures for managing MIH-related hard tissue breakdowns.

Conclusion

Conventional composite restorations and CAD/CAM ceramic restorations placed on MIH-affected teeth after cavity preparation were associated with moderate-to-high survival rates.

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Tables

Table 1
Characterization of primary dentition in the study population

	Tooth level		Surface level	
	Mean (SD)	%	Mean (SD)	%
Restorations due to caries	1.2 (1.9)	50	2.2 (3.8)	50.0
Demarcated opacities	0.2 (0.8)	66.7	0.5 (1.9)	83.3
Restorations due to MIH	0.0 (0.0)	0	0.0 (0.0)	0
dmf/nccls	2.4 (3.2)	100	4.4 (6.9)	100.0

Table 2
Detailed presentation of the number of restorations

	Non-invasive restorations		Conventional restorations	
	GIC	COMPOSITE	COMPOSITE	CAD/CAM
Treatments (%)	8.8	35.8	11.3	6.4
Mean patient age in years (SD)	7.7 (0.7)	8.9 (2.2)	10.1 (2.3)	9.7 (1.2)
Failure rate in the 1st year (%)	61.1	28.8	0.0	0.0
Mean observation time in days (SD)	242 (260)	561 (517)	1203 (835)	1186 (963)
Median survival time in days (95% CI)	240 (91-/)	742 (555-1408)	-	-