



Visual And Optical Evaluation Of Developmental Enamel Opacities Using Two Different Microinvasive Techniques: A 6 Months Follow-Up Randomized Controlled Trial

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Type of Publication: Research article

Conflicts of Interest: Nil

Abstract

Aim: To evaluate the clinical efficacy of resin infiltration technique and microabrasion in children aged 8-16 years with mild to moderate molar incisor hypomineralisation.

Methods: A total of 24 subjects aged 8-16 years, were clinically screened for mild-moderate molar incisor hypomineralization (MIH). The subjects were divided into two groups: Subjects in (Group 1) received the allocated intervention method of microabrasion using Opalustre™ (Ultradent), while the subjects in (Group 2) received the allocated intervention method of Resin Infiltration. Caries Detection and Assessment System (ICDAS) II scoring criteria was used for the visual inspection of white-spot lesion (WSL) and a DIAGNOdent pen (Ka Vo Dental Corporation, Biberach, Germany) was utilized for laser fluorescence examination. Intergroup comparison in DIAGNOdent pen scores and ICDAS II scores was recorded and assessed at various time intervals.

Results: DIAGNOdent pen and ICDAS II scores showed no significant difference between the groups at T0. A significant decrease in Diagnodent pen scores and ICDAS II scores was seen in Group 2. A significant decrease in ICDAS II scores was seen in Group 1 as well, owing to the fluoride application after intervention.

Conclusion: Resin infiltration showed significantly better improvement than Opalustre™ (Ultradent) in treating the developmental enamel opacities immediately after the intervention, 3 months later and 6 months later.

Keywords: NIL

Introduction

Physiologic performance of a natural tooth is a result of balanced relationship between biologic, mechanical, functional, and aesthetic parameters and an injury of either mechanical or biological form has an influence on these parameters.

Opaque white, yellow or brown lesion on the teeth arising from developmental cause, idiopathic cause or early carious lesions are the qualitative enamel defects caused by reduced mineralisation leading to enamel discolouration and fractures of the affected teeth¹. Such lesions are classified as Developmental Enamel Opacity or White Spot Lesions (WSLs)².

Molar-Incisor Hypomineralisation (MIH) is one such developmental defect of systemic origin, presenting as demarcated defects of enamel affecting one to four first permanent molars frequently associated with affected incisors. The term Molar-Incisor Hypomineralisation was first introduced by Weerheijm et al in 2001³. Epidemiological studies from different parts of the world show a wide variation in the prevalence of MIH ranging between 2.8 to 40.2%, affecting one in six children worldwide⁴⁻⁶.

Early diagnosis can lead to more effective and conservative management based on enhanced prevention and remineralisation. Several techniques/approaches have been employed to improve the appearance of the lesions, which includes, restorative procedures, remineralisation of enamel defects using CPP-ACP containing or fluoride containing products^{7,8}, microabrasion, bleaching technique, laminate veneer restoration and argon-laser irradiation^{9,10}.

Recently 'Resin Infiltration Technique' also known as 'Erosion-Infiltration' has been employed which utilises a very low viscosity resin capable of penetrating demineralised enamel^{11,12}. Hence, the aim of this trail was to comparatively evaluate resin infiltration technique and microabrasion in restoring aesthetics of white opacities caused by MIH.

Materials And Methods:

Ethical Approval:

The study proposal was submitted to the Research Ethics Committee, SKIMS-MCH, Bemina, Srinagar, Jammu and Kashmir, and ethical approval was obtained. All the children were invited to participate after obtaining the informed consent from parents of children through consent letters. Assent letters were obtained from the older children.

Trail Design:

This was a parallel-group, randomized controlled trail with a 1:1 allocation ratio. The type of randomization used to allocate groups will be "restricted randomization" to balance group sizes and to eliminate the experimental error. Both the investigator and the participants were blinded from knowing which intervention would be received in order to eliminate the bias after randomization. The study was conducted at Outpatient Department of Oral & Maxillofacial Surgery and Dentistry, SKIMS-MCH, Bemina, Srinagar, Jammu and Kashmir. A total of 24 subjects, aged 8-16 years, with mild to moderate molar incisor hypomineralisation were included in the study to evaluate the clinical efficacy of resin infiltration and microabrasion techniques. The design of the study followed the guidelines published by CONSolidated Standards of Reporting Trials (CONSORT). Before commencement of the study all the study procedures were explained to

every child and parents or guardians. Both consent and assent letters were obtained.

Sample Calculation:

The sample size was calculated by using the following formula (Charan and Biswas, 2013): $n=2*Z_{1-\alpha/2}^2 * X SD^2/d^2$, $Z_{1-\alpha/2}$ =Power of the study, SD: Assumed standard deviation of the study variable, d: Mean value, $n=2*1.96*1.96*(2*2)/(1.60*1.60)=12$ subjects in each group. Assuming 80% power, 5% significance level with 95% confidence interval as well as mean difference being 1.60 and assumed standard deviation of 2, the total sample size calculated is 12 patients in each group.

Participants And Eligibility Criteria:

A total of 24 subjects aged 8-16 years, were clinically screened for molar incisor hypomineralization (MIH). Inclusion Criteria included: 1. Healthy subjects (ASA I) of either gender aged 8-16 years. 2. Subjects with no history of previous orthodontic treatment and 3. Subjects free from any systemic diseases or serious health problems. Exclusion criteria included: 1. Active carious lesions. 2. Dental fluorosis 3. Children with special health care needs and Uncooperative subjects.

Intervention:

All the procedures were carried out by the single operator. Caries Detection and Assessment System (ICDAS) II scoring criteria was used for the visual inspection of white-spot lesion (WSL). A DIAGNOdent pen (Ka Vo Dental Corporation, Biberach, Germany) was utilized for laser fluorescence examination. All measurements were performed according to manufacturer's instructions.

Intervention Methods:

Microabrasion Using Opalustre™ (Ultradent)

First, isolation was done using a rubber dam. Teeth were polished and plaque was removed before the commencement of procedure. Then, 1mm thick layer of Opalustre (Ultradent Products) was applied over the labial surfaces of maxillary four incisors. Using a rubber cup attached to a contra-angle hand-piece abrasion was performed.

Resin Infiltration:

After isolating the teeth with a rubber dam, teeth were polished and plaque was removed before the

commencement of procedure. First, 37% phosphoric acid was applied over the WSL's for 2 mins. After rinsing and drying of surfaces, 70% of ethyle alcohol was applied over the tooth surfaces for 30 seconds. Followed by, application of Nexcomp Flow (flowable Composite Resin) composed of Bis-GMA on tooth surfaces and was allowed to sit for 5 mins. Subsequently it was light-cured for 20 secs.

Both the treatment procedures were assessed before intervention (baseline) (T_0), immediately after intervention (T_1), 3 months later (T_2), and 6 months later (T_3). Photographs were taken and fluoride varnish was applied to subjects in each group. The subjects were then advised to avoid brushing and flossing their teeth for the rest of the day. Also they were advised not to consume hard and sticky foods or drinking hot beverages for the next 2 hours.

Outcome Of The Study:

The outcome of the study was the differences in the developmental enamel opacities in accordance with ICDAS II scoring criteria and fluorescence values between the treatment groups immediately after intervention, 3 months later, and 6 months later.

Data Analysis:

All the data was entered into the excel sheet and was then subjected for statistical analysis. The analysis was carried out using SPSS 20.0 version (Chicago, Inc., USA). The results are presented in frequencies, percentage and mean \pm SD. The Chi-square test was used to compare categorical variables. To determine the significant difference between the groups, independent Student's t test was used. Also, the analysis of variance was used for repeated measurements of the groups followed by Tuckey test. P values below 0.05 were considered as statistically significant.

Results:

A total of 24 subjects (8 females and 16 males) were included in this study. The subjects were randomly divided into two groups, 12 in each. Subjects in (Group 1) received the allocated intervention method of microabrasion using OpalustreTM (Ultradent), while the subjects in (Group 2) received the allocated intervention method of Resin Infiltration.

DIAGNOdent pen and ICDAS II scores showed no significant difference between the groups at T_0 . A

significant decrease in Diagnodent pen scores and ICDAS II scores was seen in Group 2. A significant decrease in ICDAS II scores was seen in Group 1 as well, owing to the fluoride application after intervention.

Discussion:

This randomized and controlled clinical trial aimed to evaluate the clinical efficacy of resin infiltration technique and microabrasion in children aged 8-16 years with mild to moderate molar incisor hypomineralisation. Changes in the lesions were evaluated and recorded after applying OpalustreTM (Ultradent) and resin infiltrate to the developmental enamel opacities and white spot lesions. Hypomineralized and demineralized surfaces of teeth were assessed according to ICDAS II scoring criteria and DIAGNOdent pen measurements.

White spot lesions can be either non-carious or carious, typically involving maxillary anterior teeth or can be seen throughout the dentition, having smooth and shiny appearance¹³. Tooth dentin contains atoms, known as, fluorophores which appear green under the blue laser light. While as, in presence of white spot lesion, it appears as black area surrounded by green reflected color, seen as fluorescence loss¹⁴. This difference in the refractive index of the enamel and lesion crystals, contribute to the whitish nature of white spot lesions¹⁵.

Minimally invasive techniques have become more important in preserving the integrity of healthy tooth tissue as well as improving the esthetic concerns. These procedures are well tolerated by the patients and much preferred over the restorative treatment modalities.

Although white spot lesions have the ability to naturally remineralize themselves by taking up the minerals from saliva, but these minimally invasive techniques are helpful in masking the developmental opacities in the hypomineralized areas thereby, improving esthetics and structural properties of deeper lesions. Enaia et al, concluded, 57.1% of white spot lesions improved, 26% remained the same, and 16.7% became worse after a 1-year follow up without treatment. Therefore, a spontaneous method used to treat such lesions can take a long duration of time to remineralize and also the esthetic needs will fail to meet¹⁶.

Very few studies have shown that resin infiltration technique provides better recovery in terms of esthetic needs as well as preserving the structural integrity of tooth, by penetrating deeper with shorter effect period after treatment as compared to microabrasion technique using Opalustre™ (Ultradent)¹⁷⁻¹⁹. A significant increase in the lightness of the white spot lesions was seen immediately after the application of resin infiltrate (T₁) and a subsequent increase from T₁ to T₃ (Table 2), suggesting the durable nature of the material. Whereas, there was no significant visible change seen immediately after the application of Opalustre™ (Ultradent) and the subsequent increase from T₁ to T₃ was also not statistically significant. This was in accordance with the results shown by Knosel *et al*^{20,21}, who reported no difference in lesion findings at the end of 6 mo and Eckstein *et al*²², found no difference at the end of 12 mo.

Munoz *et al*²³, found that resin infiltrate penetrates into active carious lesions when compared to inactive carious lesions. They concluded that the developmental opacities cannot be totally masked through resin infiltration techniques because of the thicker surface area of lesion, similar to that of inactive carious lesions.

Minimal invasive techniques represent a new concept in dentistry, offering a high acceptance by patients as well as beneficial clinical applicability for the clinicians. Such techniques are not only effective in treating smooth-surface lesions but also provide an alternative approach to treat early carious lesions that are not expected to remineralize or arrest on its own. Resin infiltration technique aims to fill the intercrystalline spaces within body of lesion, thereby, acting as diffusion pathway for acids and dissolved minerals, hence sealing the lesion without a covering resin coat. Hence, this technique is considered as micro-invasive technique, thereby, bridging the gap between the non-invasive and minimally invasive treatment modalities for white spot lesions.

Conclusion:

Resin infiltration showed significantly better improvement than Opalustre™ (Ultradent) in treating the developmental enamel opacities immediately after the intervention, 3 months later and 6 months later. Thus, we concluded that treating white spot lesions with resin infiltration technique was a better

treatment option due to its short term esthetic recovery and high patient satisfaction. Also, DIAGNOdent pen values decreased with time, hence, masking the lesions partially.

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FIGURE 1: Pre and post operative microabrasion and resin infiltration-6 months follow up



TABLE 1: Frequency distribution based on demographic analysis

	Group 1	Group 2	Total
Gender	N%	N%	N%
Male	10 (62.5%)	6 (37.5%)	16 (100%)
Female	3 (37.5%)	5 (62.5%)	8 (100%)

TABLE 2: Intergroup comparison of DIAGNOdent pen scores among subjects at various time intervals:

Groups	Time	DIAGNOdent scores (mean±SD)	Comparison between different time intervals	p-value
Group 1	T ₀	4.60±1.34	T ₀ -T ₁	0.49
	T ₁	4.39±1.25	T ₀ -T ₂	0.09
	T ₂	3.14±1.55	T ₀ -T ₃	0.93
	T ₃	3.12±1.05		
Group 2	T ₀	4.44±1.52	T ₀ -T ₁	0.00**
	T ₁	2.85±1.42	T ₀ -T ₂	0.00**
	T ₂	2.06±1.07	T ₀ -T ₃	0.00**
	T ₃	1.43±0.80		

SD= Standard Deviation

TABLE 3: Intergroup comparison of ICDAS II scores among subjects at various time intervals:

Groups	Time	ICDAS II scores	Comparison between different time	p-value
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		(mean±SD)	intervals	
Group 1	T ₀	1.54±0.45	T ₀ -T ₁	0.001**
	T ₁	0.55±0.63	T ₀ -T ₂	0.001**
	T ₂	0.53±0.55	T ₀ -T ₃	0.001**
	T ₃	0.50±0.57		
Group 2	T ₀	1.55±0.52	T ₀ -T ₁	0.00**
	T ₁	1.55±1.42	T ₀ -T ₂	0.00**
	T ₂	1.39±1.07	T ₀ -T ₃	0.00**
	T ₃	1.33±0.80		

ICDAS= International Caries Detection and Assessment System; SD= Standard Deviation

Intergroup comparison in DIAGNOdent pen scores and ICDAS II scores at various time intervals are shown in Table 2 and 3