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Comprehensive Assessment of Correlations of Sodium Hypochlorite Application and Etching Patterns in Primary Molars of Pediatric Patients: An Original Research Study

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ABSTRACT:

Background and Aim: Placement of tooth coloured restorative material on enamel usually necessitates enamel etching procedures since decades. In pediatric patients, literature has shown variety of etching patterns in healthy and compromised enamel. However, they all do not mandatorily affect clinical performance of materials in their long term service. The sole endeavour of present study was to assess the correlations of sodium hypochlorite application and etching patterns in primary molars of pediatric patients.

Materials & Methods: Total twenty five deciduous molars those affected from Amelogenesis imperfect type three, were included in this study. Teeth were collected at the time of their natural exfoliation. NTI® Turbo Crown Cutters Diamond Discs was utilized to section the tooth into equal buccal and lingual halves. The ultimate aim of sanctioning of teeth was to reveal the fresh enamel surface. Group one samples included buccal surfaces of one side of all samples. HoEtch 37% Phosphoric Acid Etching Gel was used to etch the prepared enamel surfaces as per the manufacturer's instructions. Group two samples were pre-treated with sodium hypochlorite (NaOCl; 5.25%). After pre-treatment with NaOCl, all group two samples were subjected to same procedure of etching with HoEtch's 37% phosphoric acid etch gel. All samples were examined for surface change at five different locations under scanning electron microscope.

Statistical Analysis and Results: Statistical analysis was completed by using statistical software Statistical Package for the Social Sciences version 21. Out of 25 patients, males were 15 and females were 10. All studied participants were divided into four age groups. 7 patients were found in the age of 9/<9 years. 8 patients were identified in the age of 10 years. Level of significance evaluation by pearson chi-square test revealed that p value was significant type II, III, IV etching in group 1. Level of significance evaluation by pearson chi-

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square test revealed that p value was significant type III etching in group 2. Data comparison among the 2 study groups using one-way ANOVA showed highly significant p value. **Conclusion:** Within the limitations, they stated that surface treatment of primary teeth firstly by 5.25% NaOCl followed by traditional application of phosphoric acid considerably creates favourable etching pattern. These favourable etching patterns are very critical for mechanical retention of Composite restorations, Inlays, Crowns, Veneers and Pit and fissure sealing.

Key Words: *Enamel Hypoplasia, Etching, HoEtch's Phosphoric Acid Etch Gel, NaOCl*

I. INTRODUCTION

It is an established fact that Amelogenesis imperfecta is a genetic disorder of enamel that involves both the primary and permanent dentition. By definition, Amelogenesis imperfecta happens only where enamel defects occur in the absence of other syndromes or metabolic disorders.[1] Literature has well showed that relative incidence of Amelogenesis imperfecta ranges from 1 in 720 to 1 in 13,500 depending on the populace studied. Amelogenesis imperfect usually express in inconsistent form in its clinical behavior.[2,3,4] Several authors have stated that mutations in various genes. Traditional composites resin and resin-modified glass ionomers, are the treatment of choice for restoration of teeth involved by Amelogenesis imperfecta.[5,6] In literature, several authors showed that the adhesion largely depends good etching. Optimal etching is usually achieved by selective elimination of the prismatic and inter-prismatic crystals responsible for surface roughness and micro-irregularities. These surface roughness and micro-irregularities allow adequate monomer penetration, enhanced retention and bonding strength. These entire phenomenons happen between the enamel and the restoration material.[7,8] Several pioneer workers have shown that retention of dental resin materials is improved significantly by pretreatment of the enamel surfaces with some effective chemical agents. Such acidic solutions primarily work by incomplete decalcification of the enamel. The process of decalcification produces micro irregularities on the surface of the teeth. This process of acid etching, has received great attention from researchers since decades.[9,10,11] This study was attempted to evaluate the correlations of sodium hypochlorite application and etching patterns in primary molars of pediatric patients.

II. MATERIALS & METHODS

This study was planned, outlined and executed in the department of Pedodontics and Preventive dentistry of the institute. Sample selection included twenty five deciduous molars those affected from Amelogenesis imperfect type three. In this type, enamel is defected because of malfunction of enamel calcification. Consequently enamel is formed of standard thickness but is exceptionally brittle, with an opaque/chalky appearance. Teeth are highly susceptible to staining and rapid wear, resulting into dentine exposure. Condition is of autosomal dominant and autosomal recessive pattern. All sample teeth were collected at the time of their natural exfoliation. Without a doubt, an informed consent from patients/parents was taken to use the exfoliated primary teeth in the research. Teeth with fracture line, carious or filled were excluded from the study during sample selection procedure. Sample teeth were cleaned thoroughly to make it free from all contaminations. For preservation purpose, sterile

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water was used at normal room temperature. All samples were stored into separate containers to avoid cross contaminations and adherence. NTI® Turbo Crown Cutters Diamond Discs (C-10HP) was utilized to section the tooth into equal buccal and lingual halves (Kerr Corporation, NY City, USA). As per guidelines mentioned in the literature, we ensured to restrict the maximum speed. We had also ensured to discard the discs after every 4 preparations. The sole function of sanctioning of teeth was to reveal the fresh enamel surface. Group one samples included buccal surfaces of one side of all samples. HoEtch 37% Phosphoric Acid Etching Gel was used to etch the prepared enamel surfaces as per the manufacturer's instructions. HoEtch roughens the surface, increases retention of resin sealant, and promotes mechanical retention. Additionally, HoEtch's 37% phosphoric acid etch gel efficiently removes the smear layer, which helps in successful bonding. Group two samples included buccal surfaces of other side of all samples. Group two samples were pre-treated with sodium hypochlorite (NaOCl; 5.25%). After pre-treatment with NaOCl, all group 2 samples were subjected to same procedure of etching with HoEtch's 37% phosphoric acid etch gel. Drying, washing was conducted as per recommendations of manufacturer. All samples were examined for possible surface change at five different locations under scanning electron microscope. All images were saved into electronic format for further assessment and categorization. All changes and findings were categorized into four different types of etching patterns as per proposed by Galil KA and Wright GZ.[8] The privacy and other incorporated rights of the patients along with their freedom of expression were not disclosed. Results thus received was compiled in table and subjected to basic statistical analysis. P value less than 0.05 was considered significant ($p< 0.05$).

III. STATISTICAL ANALYSIS AND RESULTS

In the present study, all noticeable findings and data were compiled in rationally. Compiled data was sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The processed data was subjected to suitable statistical tests to obtain p values, mean, standard deviation, chi- square test, standard error and 95% CI. Table 1 and Graph 1 showed that out of 25 patients, males were 15 and females were 10. All studied participants were divided into four age groups. 7 patients were found in the age of 9/<9 years. P value was not significant here. 8 patients were identified in the age of 10 years. P value was not significant for this age group. Total 8 patients were noticed in the age of 11 years. P value was significant for this age group (0.01). Total 2 patients were noticed in the age of 12 years. Table 2 showed distribution of Etching patterns in study groups as per Galil KA and Wright GZ. Table 3-6 showed basic statistical description with level of significance evaluation using Pearson chi-square test [for Group 1 and 2]. Level of significance evaluation by pearson chi-square test revealed that p value was significant type II, III, IV etching in group 1. Level of significance evaluation by pearson chi-square test revealed that p value was significant type III etching in group 2. Table 7 showed data comparison among the 2 study groups using one-way ANOVA [for Group 1 and 2]. The measured p value was extremely significant (0.001).

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Table 1: Age & gender wise allocation of patients

Age Group (Yrs)	Male	Female	Total	P value
9/<9	3	4	7	0.70
10	5	3	8	0.50
11	6	2	8	0.01*
12	1	1	2	0.09
Total	15	10	25	***Significant**

Table 2: Distribution of Etching patterns in study groups as per Galil KA and Wright GZ[8]

Etching Patterns	No. of locations [Group 1: 125]	No. of locations [Group 2: 125]	Total Studied Locations
Type I Etching	42	51	250
Type II Etching	27	21	
Type III Etching	26	27	
Type IV Etching	30	26	

Table 3: Fundamental statistical interpretation [for group 1]

Etching Patterns	Mean	Std. Deviation	Std. Error	95% CI
Type I Etching	12.41	0.834	0.726	1.19
Type II Etching	8.47	0.342	0.384	1.96
Type III Etching	7.52	0.849	0.928	1.72
Type IV Etching	9.59	0.938	0.283	1.92

Table 4: Level of significance evaluation by pearson chi-square test [for group 1]

Etching Patterns	Pearson Chi-Square Value	df	Level of Significance (p value)
Type I Etching	1.454	1.0	0.09
Type II Etching	1.345	2.0	0.01*
Type III Etching	2.865	1.0	0.02*
Type IV Etching	1.425	1.0	0.01*

***p<0.05 significant**

Table 5: Fundamental statistical interpretation [for group 2]

Etching Patterns	Mean	Std. Deviation	Std. Error	95% CI
Type I Etching	11.43	0.939	0.029	1.02
Type II Etching	6.43	0.373	0.526	1.96
Type III Etching	7.23	0.842	0.287	1.65
Type IV Etching	4.21	0.922	0.253	1.31

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Table 6: Level of significance evaluation by pearson chi-square test [for group 2]

Etching Patterns	Pearson Chi-Square Value	df	Level of Significance (p value)
Type I Etching	1.727	1.0	0.50
Type II Etching	1.032	2.0	0.08
Type III Etching	2.527	1.0	0.02*
Type IV Etching	1.739	1.0	0.09

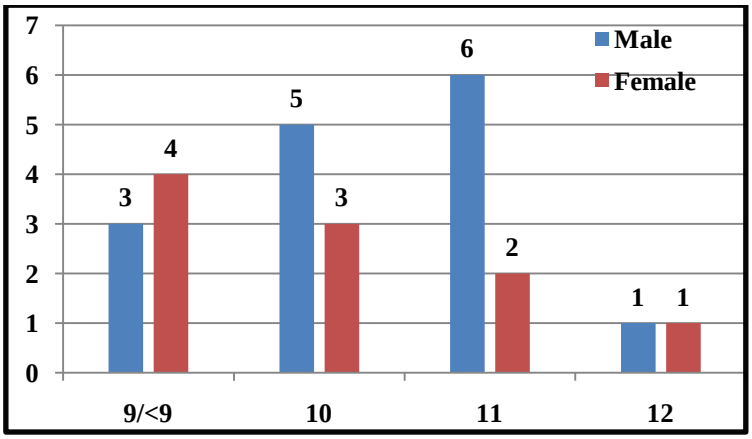
***p<0.05 significant**

Table 7: Comparison of data among the 2 study groups using one-way ANOVA [for group 1 & 2]

Parameters	Degree of Freedom	Sum of Squares ∑	Mean Sum of Squares m∑	F	Level of Significance (p value)
Between Groups	2	3.676	1.909	5.433	0.001*
Within Groups	35	12.946	0.276	-	
Cumulative	348.87	16.344	-		

***p<0.05 significant**

Graph 1: Age & gender wise allocation of patients



IV. DISCUSSION

Sodium hypochlorite (NaOCl) is considered as a strong solution for denaturing protein. Any type of surface irregularity of enamel can be revealed directly on extracted human teeth. Furthermore, it can be indirectly seen on enamel surface using scanning electron microscope (SEM). The process of deproteinization eliminates the organic substance which can increase the enamel surface area and therefore creates bonding more proficient.[12,13] Various researchers have demonstrated the concept of enamel deproteinization with 5.25% sodium

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hypochlorite (NaOCl) before phosphoric acid (H_3 PO_4) etching. They have also shown the effect of this pre treatment on the etching patterns as well as on the shear bond strength of the adhesive system. It has been evidenced that the effectiveness of enamel etching is greatly altered by numerous biomedical parameters. The ultimate quality of etched enamel depends on the nature and concentration of the acids, etching and rinsing time, composition and situation of the enamel surface as well as the amount of organic matter removal. By composition and nature, NaOCl is a non-specific proteolytic agent which is efficient in eliminating organic compounds without harming healthy tissue or tooth structure.[14,15] Originally, the concept of enamel deproteinization using NaOCL before acid etching (pre treatment) of Amelogenesis imperfecta teeth was first depicted by Venezie et al 1994.[16] Venezie et confirmed that enamel pre treatment with 5% NaOCL for one minute improves the bonding of an orthodontic bracket to a permanent tooth affected with hypocalcified Amelogenesis imperfecta. Many researches in the past have been conducted to examine the outcome of enamel deproteinization with 5.25% NaOCl, before or after phosphoric acid etching application.[17,18] They checked for the etching pattern and bond strength of adhesive systems to sound permanent teeth; however their outcomes had been controversial. Also, the precise adhesion between enamel and resin is extremely dependant on enamel surface details and roughness. If there is any modification in the physical and chemical structure of enamel, adhesion between enamel and resin can be difficult to achieve sufficient bond strength. This is primarily because the etching pattern created by phosphoric acid on normal enamel may not happen on the affected teeth. Therefore many of the past studies aimed to augment the properties of the enamel to get improved retention of the adhesive materials.[7,12,19]

V. CONCLUSION

Authors have drawn few very significant conclusions from this study. Within the limitations, they stated that surface treatment of primary teeth firstly by 5.25% NaOCl followed by traditional application of phosphoric acid considerably creates favourable etching pattern. These favourable etching patterns are very crucial for mechanical retention of composite restorations, Inlays, Crowns, Veneers and Pit and fissure sealing. It is therefore suggested to perform initial surface treatment of primary teeth by NaOCl to increase success rates particularly in cases of Amelogenesis imperfect type three. However, authors had not included the potential effects of few important factors like oral temperature and salivary parameters. Nonetheless, authors anticipate few other genuine studies to be conducted with larger sample size and wider study parameters.

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