

COMPARATIVE SEM EVALUATION OF ETCHING PATTERNS USING ETCHANT GEL AND SOLUTION – AN INVITRO STUDY

Dr. Shilpa A.*¹, Dr. Saravanakumar M. S.², Dr. Anjana G.³, Dr. B. Muralikrishnan⁴, Dr. Vidya Manoharan⁵,
Dr. Amrutha Joy⁶

¹Post Graduate Department of Pedodontics and Preventive Dentistry Royal Dental College Palakkad, Kerala, India.

²Professor Department of Pedodontics and Preventive Dentistry Royal Dental College Palakkad, Kerala, India.

³Professor and Head Department of Pedodontics and Preventive Dentistry Royal Dental College Palakkad, Kerala, India.

⁴Reader Department of Pedodontics and Preventive Dentistry Royal Dental College Palakkad, Kerala, India.

^{5,6}Senior Lecturer Department of Pedodontics and Preventive Dentistry Royal Dental College Palakkad, Kerala, India.

*Corresponding Author: Dr. Shilpa A.

Post graduate Department of Pedodontics and Preventive Dentistry Royal Dental College Palakkad, Kerala, India.

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ABSTRACT

Background: Etching of the enamel surface improves the bond strength was first introduced by Bunocore in 1955. Over the years, a lot of developments have occurred in the etching time and the materials used. Nowadays, etchants are available in both gel form and solution. Both the form of etchant claim to provide better bond strength than the other. The aim of this study is to compare and evaluate the etching pattern of two commercially available gel and solution etchants using SEM. **Materials and methods:** Twenty mandibular first premolars extracted for orthodontic purpose were included in the study. The selected teeth will be divided into two groups. One group will be etched with etchant solution and the other with etchant gel. On completion of the etching procedure, the teeth will be desiccated and coated with gold – palladium in preparation for examination under SEM to observe the etching pattern. **Results:** In Group A samples treated with 37% phosphoric acid gel – EAZETCH gel shows Type II etching pattern and in Group B samples treated with 37% phosphoric acid solution – 3M solution shows Type I etching pattern. **Conclusion:** Findings of the present investigation revealed that 3M solution provided more uniformity in the etching pattern compared to that of EAZETCH gel and from this it can be concluded that etchant in the form of solution will be more effective than etchant in the form of gel.

KEYWORDS: Acid etching, etching gels, etching solution, etching pattern, scanning electron microscope.

INTRODUCTION

A clinician's ability to bond a restoration to enamel has influenced changes in prosthetic and cavitory preparations, restorative approaches for esthetic corrections, bonding techniques for orthodontic devices, and the treatment of caries. Bonding to enamel has over 50 years of history. Efforts have been made to develop or introduce a simplified alternative, but enamel acid etching remains the most effective procedure for stable enamel bonding.^[1]

'Acid etching' is the use of an acidic substance to prepare the tooth's natural enamel for the application of an adhesive. The acid roughens the surface microscopically, increasing retention of resin sealant. Etching of dental enamel with acid removes the smear layer and opens enamel tubules. Concept of etching enamel surface which improves the bond strength was first introduced by Bunocore in 1955.^[2] Over the years a lot of developments have occurred in the etching

technique and the materials used. Previous research on acid etching has focused primarily on acid solutions. Over the past several years, gels for etching enamel have appeared in the market and have replaced acid solutions as the etchant of choice of many clinicians. Both the forms of etchant claim to provide better bond strength than the other.

Gels are thixotropic in nature. Because of this property, gels allow for increased control in placement and thus offer a distinct technical advantage to the clinician in terms of convenience.^[3] With gels, it is possible to reduce or eliminate acid overflow to gingival tissues and to avoid accidental etching of hard tissues adjacent to the desired site.^[4]

Despite these apparent advantages, there has been contradictory documentation in the literature on whether gels are as effective as acid solutions. Some have noted that due to the viscous nature of gels, their ability to wet

the enamel surface effectively may be reduced. Others have stated that by-products from the etching reaction form at the enamel-gel interface and reduce the effect of the acid; they contended that these by-products are eliminated only when fresh acid is applied continuously.^[3]

Based on these facts the main aim of this study was to evaluate the etching pattern of two forms of commercially available etchants using scanning electron microscope.

MATERIALS AND METHODS

Twenty mandibular first premolars extracted for orthodontic purpose were included in the study. Root portions were cut at the level of CEJ followed by longitudinal sectioning of samples in a bucco lingual direction using carborundum disc (Fig.1).



Fig. 1: Bucco lingual sectioning.

Sectioned samples were randomly divided into two groups, Group A (EAZETCH Gel - ANABOND) and Group B (3M Solution). Facial surface of each specimen was thoroughly cleaned using a rubber cup in a slow speed hand piece with pumice slurry (Fig.2).



Fig. 2: Prophylaxis.

Samples in Group A were treated with 37% phosphoric acid gel (EAZETCH gel -ANABOND) (Fig.3) and in Group B treated with 37% phosphoric acid solution (3M solution) (Fig. 4).



Fig. 3: Group A.

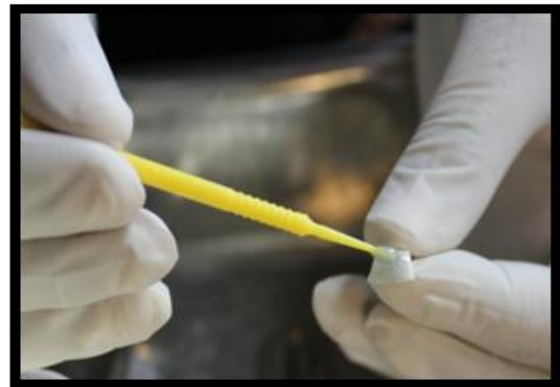


Fig. 4: Group B.

After 15 seconds samples in both groups were rinsed with water for 20 seconds and then air dried for 10 seconds. After completing the etching procedure, the specimens were desiccated in a vacuum oven for 24 hrs. Then the samples were mounted on an aluminum stub for gold sputtering. Photomicrographs of each specimen were obtained at a magnification of 1000x.

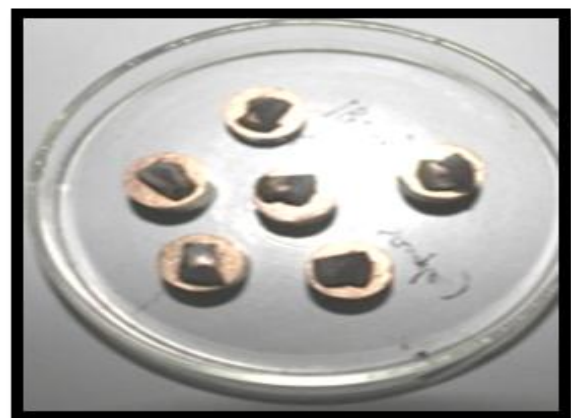


Fig. 5: Gold sputtered samples in SEM stub.

RESULTS

Scanning electron photomicrographs representative of those obtained in the study are illustrated in Figure 6 (acid gel) and Figure 7 (acid solution).

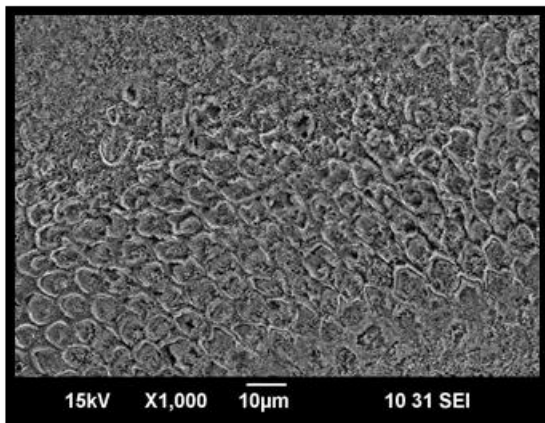


Fig. 6: Group A, EAZ ETCH gel.

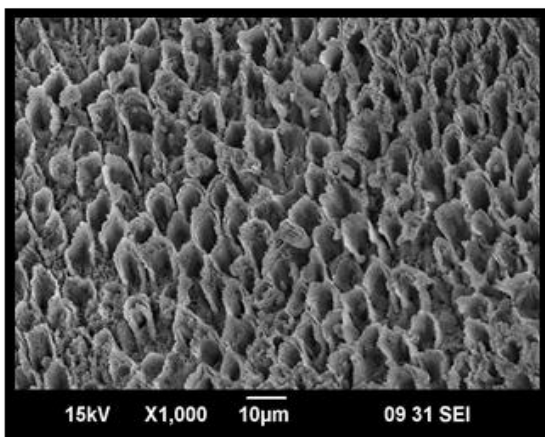


Fig. 7: Group B, 3M solution.

Fig. 6 represents Group A (EAZETCH gel) showed Type II etching pattern in an unevenly distributed pattern. Fig. 7 represents Group B (3 M solution) showed Type I etching pattern in a uniformly distributed manner.

DISCUSSION

When enamel is treated, the acid removes about 10 µm of enamel from the surface and selectively dissolves the ends of the enamel rods in the remaining enamel. This creates porosities 25 to 75 µm deep that act as a system of channels into which an unfilled resin or resin bonding agent can flow and that increase the surface area more than 2000 times. These changes greatly strengthen the mechanical bond between the tooth and resin.

Bunocore used 85% phosphoric acid. Later studies have shown that etching with 20 to 50% phosphoric acid creates the deepest channels in permanent enamel. And finally research suggests 37% phosphoric acid is the ideal concentration.^[5]

Silver stone *et al.*^[6] described and classified three types of etching pattern of which Type I had enamel prism cores preferentially removed. Type 2 was the reverse pattern where the peripheral regions of the prisms were removed leaving relatively unaffected prism cores. Type 3 had areas corresponding to both Types 1 and 2. Ripa *et al.*^[7] and Gwinnet.^[8] described about Type 4 etching pattern where etched prismless enamel displays no rod or prism patterns. Wei,^[9] described about Type V etching pattern which is extremely flat and smooth, and they lack micro irregularities for penetration and retention of resins.

In the present study Group A showed Type II etching pattern (37% phosphoric acid gel – EAZETCH gel) contradicting to the Type I etching pattern observed with Group B (37% phosphoric acid solution – 3M solution). This is in accordance with the studies conducted by Galil *et al.*,^[10] Silver stone *et al.*^[6] and Walker *et al.*,^[11]

The Type I etchant pattern revealed a more deepened prism cores with intact peripheral prism boundary and a more even distribution pattern, whereas, the Type II etching distribution pattern noted was less even. These findings are corresponding to the study made by Galil *et al.*^[10]

In the case of gel its viscous nature reduces their ability to wet the enamel surface effectively. By products from the etching reaction form at the enamel gel interfaces which reduce the effect of acid and moreover longer wash time is necessary to remove gel residues from the etched enamel surface.^[10]

Therefore when low viscosity fluid resin contacts the surface, it is attracted more through the capillary interaction which helps in formation of resin tags for an adequate long lasting bonding by micromechanical interlocking and the continuous application of solution helps to eliminate the by products that will be formed as a result of etching reaction.^[12,13,14,15]

CONCLUSION

Findings of the present investigation revealed that 3M solution provided more uniformity in the etching pattern compared to that of EAZETCH gel and from this it can be concluded that etchant in the form of solution will be more effective than etchant in the form of gel.

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