Saudi Journal of Medical and Pharmaceutical Sciences **ISSN 2413-4929 (Print)**
Scholars Middle East Publishers **ISSN 2413-4910 (Online)**
Dubai, United Arab Emirates
Website: https://saudijournals.com/

Etching Gels

Zbigniew Raszewski (PhD)*
WSM Bialystok, Jana Sobieskiego 3, 15-013 Białystok, Poland

Original Research Article

***Corresponding author**
Zbigniew Raszewski

Article History
Received: 09.12.2018
Accepted: 19.12.2018
Published: 30.12.2018

DOI:
10.36348/sjmps.2018.v04i12.012

Abstract: Aim of this work was to compare properties of two etching gels produce by Kerr Orange and Spofa Dental. Etching gel are water solution of phosphoric acid using in total etch techniques. They are applicable on enamel surface for 30 seconds to make partially dissolving of hydroxyapatite crystals and increase mechanical adhesion between bonding agents and tooth structure. Materials and methods two commercial phosphoric acid gels (Kerr and Spofa Dental) were tested in consistency, thixotropic properties, water disintegration, force necessary for extrusion material from syringe, fil thickness. Results: Kerr materials has higher consistency, is less thixotropic compare to Spofa product, has longer time to dissolve (18 min), lower force necessary to extrusion 5 N and film thickness 4 microns. Conclusion: On the market exist etching gel based on different gelling agent organic gums or fumed silicas. Some clinician prefer material with higher viscosity for some application, other groups of practicing doctors are using less viscous materials.
Keywords: Etching gel, consistency, thixotropy, gel disintegration.

INTRODUCTION

The first person who noticed and used phosphoric acid to increase bonding strength was the father of contemporary dentist Buonocore. In 1955, he noticed that the solution of phosphoric acid with short bristles improved the adhesion of the acrylic resin to the tooth [1-7].

Enamel is one of the hardest tissue in human body, mainly component 96% is hydroxyapatite, crystals. To dissolve such inorganic component some mild of strong acids are need most frequently phosphoric acid is using [7].

Originally, standard treatment time for enamel conditioning was 60 seconds. However, several studies have indicated that a 15-second etching time provides similar surface morphology and bond strength values [3-5].

In dentistry, in the total etch method, gel is used based on phosphoric acid, their task is to superficially dissolve hydroxyapatite crystals on the enamel surface. Such process enhances the topography of enamel, demineralisation process is much more effective because of difference of angulation of the prisms in certain regions- head of the prisms. Acid etching removes approximately 10 µm of enamel with characteristic porous layer 5 -50 µm [8, 9].

This treatment enables better penetration of bonding agent and a good connection between the tooth structure and the final composite material. Bonding agents are low viscosity methacrylic resin based mainly in tri ethylene glycol dimethacrylate, 2 hydroxy ethyl methacrylate and lower concentration of high viscosity like bis -GMA for contraction decreasing. After polymerization of the bonding agent, a durable attachment to the enamel surface is achieved by micromechanical interlocking. The strength of the connection between the composite resin and the enamel surface etched with phosphoric acid is from 20-25 MPa, which is a safe value from a clinical point of view [6, 9].

Some authors tested phosphoric acid gels before self- etching primers. They observe higher solubility of enamel prisms using these two techniques. For good bonding force to dentin, self- etching system are commonly used today [1, 6].

The optimal concentration of phosphoric acid in the gel is about 35% although there are productions containing concentrations. Concentrations greater than 50% resulted in the formation of a monocalcium phosphate monohydrate that inhibits further dissolution, but in concentrations not lower than 10% the phosphoric acid solution did not produce adverse effects on the bond strength [10].

Aim of this work was to compare properties of two etching gels produce by Kerr Orange and Spofa Dental.

MATERIALS AND METHODS

Three syringes of each material were used for testing. Kerr product pink in colour has a batch number 6767543, Spofa material in blue colour has a batch number 6965918. After extrusion from syringe it is possible to observe a difference between these two gels. Kerr etching gel has a lower consistency probably contains some organic gelling agent inside. Spofa product has higher viscosity and probably is composed based on fumed silica.

Consistency

Gel sample 0.5 g was placed on the glass slabs and covered with second glass and weight to total mas 1 kg. After 10 second diameter of the circle was measure with calliper. These tests were performed according the US 6,537,563 B2 [11].

Thixotropy

Three samples of gel 0.1 g each was applicable on beginning directly from syringe and after using a needle 0.55 mm. Samples left on the vertical glass doesn't move for 10 minutes (testing time). New portion of gel was extruded on the glass slab and it was fixed in vibration table and instrument was switch on during 10 second in vibration speed nb.6. Distance made by each gel was measured after end of test. Performed tests and results are in photos below.

Fig-1: Samples before test extracted directly from syringes

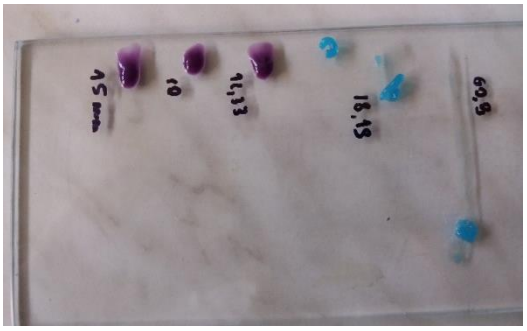

Fig-2: Samples after 10 second of vibration

Disintegration Time

Sample of 0.2 gram was placed in PMMA disk which was fixed in laboratory beaker filled with distilled water. 2 ± 2 mm was maintained between the paddle and the surface of the disk assembly. The whole was placed on a magnetic laboratory mixer, which rotated at a speed of 200. The time at which a sample of a gel will peel from the plastic surface and dissolve in water was examined. For each gel this test was repeated three times [12].

Force need for extrusion form syringes

Syringes with needle 0.55 mm were fixed in Shimadzu compressive instrument and force need for extrusion was measured. A constant speed of 4 mm/min, so that the etching gel was extruded from the Syringe stably, and the force required for depressing the Syringe, i.e., the extrusion force, was observed, according to US 2012/01 61067 A1 [13].

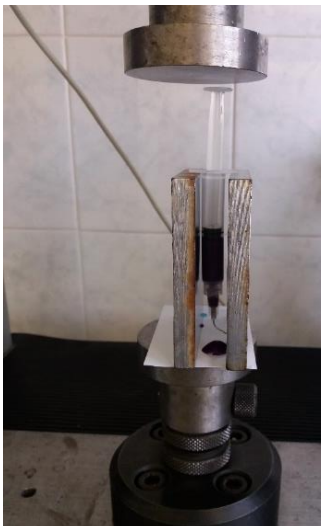

Fig-3: Extrusion force measurement in Shimadzu compressive strength instrument

Film Thickness

Material 0.02 g was extruded on the special cylindrical glass (procedure adapted from Kavitan film thickness measurement). After it was placed under mass 15 kg for 1 minutes (according below picture). Samples was transferred to micro meter and thickness was measured.

Fig-4: Samples on etching gel in under 15 kg force in mico meter

RESULTS

Tables below show results from the tests. Etching gle prodcue in Kerr has higher consistency that Spofa product.

From the tests it will be visible that gel made in Spofa is flowing under vibration when is extrude by small needle, in contrast to the gel from Kerr. This is connected directly with composition. Water solution of fumed silica after extrusion through pipes with low diameters for a small period flow more compare to sample not disturbed. Gel made by Kerr has as gelling agent based on organic gum which works different under vibration

Table-1: Results from the consistency measurement

Kerr	Spofa
35 mm	26-29mm

Table-2: Results from thixotropy measurement

Kerr	Spofa
20.5 +/-1.4 mm	57+/- 2.7 mm

Table-3: Results from disintegration time measurement

Kerr	Spofa
14 +/- 2 min	2+/- 20 sec

Big difference between disintegration time relates to composition. Silica can be easily washed out with running water compare to organic materials from Kerr product.

For extrusion an etching gel through the needle is necessary to use lower force in Kerr material.

After testing of film thickness it was possilbe to bserve difference in diamterer of materials used forgel forming. Kerr material has lower particles inside.

Table-4: Results from the extrusion tests

Kerr	Spofa
5+/- 1 N	17+/-2 N

Table-6: Results from the film thickness measurement

Kerr	Spofa
4.5 µm	8.5 µm

DISSUSION

One of the important requirements of etching gels is that they remain in the place after the application. This is especially important when etching V class surfaces. The acid can not get into the vicinity of the gingival pocket or soft tissue. One of the laborator tests is the checking the consistency of the material. If the material under the influence of a small force is spreading, it may lead to the fact that it will drift from the vertical surfaces during clinicla application. Such test was proposal in US 6,537,563 B2 [11]. This invention describe to use different nanosilica for etaching gel. Authors performed a consistency test for two kinds of nano silica and 3 comersial gels (Vivadent Totla Etch, Jeneric Penron and Bisco). Disc diamter made from gel were from 30-50 mm. Which is simillar to resuts from current investigation.

In the same sorce is possible to find information about film thickness. The commersial gels has this paramter from 6-8 µm. These two gel tested in this work has the same value.

Other imporatnt parametr which is closly connected with consistency is tixotropy. Materials which can fomr a gels under the influence of the applied forces, the material that forms the gel can reduce its viscosity. This means that in a short time after application, the material may flow out after the place of its dispensing. This happens then if the gel is forced through the thin needle for the application. On this are more sensitive materials, which in their composition have pyrolytic silica. Tixotropy testes under vibration table performed in this work clearly show that gel on the basis of fumed silca is flowing more [2, 4, 9, 10].

US 2012/01 61067 A1 describes to use carboxy methyl celulose as a gelling agnets in ethcing gels. In their work they preformed an extrusion test of final material from syringes [13]. Conclusion from this test is that extrusion force must be lower than about 10 N to prevent the etching gel from clogging the needle in practical operation. Furthermore, the measurement value of the extrusion force must be higher than about 6 N, so that the etching gel is not so fluid as to cause damage to the surrounding tissues of the tooth of the patient in practical use. Results from current investigation shows that Kerr materal has lover extrusion force and Spofa material has higher. But booth of them are using by praticioners for many years. It means that values describe in patent can be used only as a guide.

Gel desintegration test was followed byUS Pharmacopeia, according to the description of the Paddle over Disk method. From this investigation it is clearly visible that material on the basis of fumed silica has shorter desintergation time. Form the clinicla point of view it can be an adventage during the washing procedure after 30 seconds of etching [9].

CONCLUSION

On the market exist etching gel based on different gelling agent organic gums or fumed silicas. Some clinician prefer material with higher viscosity for some application, other groups of practicing doctors are using less viscous materials

ACKNOWLEDGEMENTS: Any

CONFLICT OF INTEREST: None

REFERENCES

1. Lima, A. F., da Silva, V. B., Soares, G. P., Marchi, G. M., Aguiar, F. H. B., & Lovadino, J. R. (2012). Influence of previous acid etching on interface morphology and bond strength of self-etching adhesive to cavosurface enamel. *European journal of dentistry*, *6*(1), 56.

2. Shinchi, M. J., Soma, K., & Nakabayashi, N. (2000). The effect of phosphoric acid concentration on resin tag length and bond strength of a photo-cured resin to acid-etched enamel. *Dental Materials*, *16*(5), 324-329.
3. Bates, D., Retief, D. H., Jamison, H. C., & Denys, F. R. (1982). Effects of acid etch parameters on enamel topography and composite resin-enamel bond strength. *Pediatr Dent*, *4*(2), 106-10.
4. Turner, C., Courts, F. J., & Gombola, G. G. (1987). The removal of phosphoric acid and calcium phosphate precipitates: an analysis of rinse time. *Pediatr Dent*, *9*, 208-211.
5. Khosravi, K., Ataei, E., Mousavi, M., & Khodaeian, N. (2009). Effect of phosphoric acid etching of enamel margins on the microleakage of a simplified all-in-one and a self-etch adhesive system. *Operative dentistry*, *34*(5), 531-536.
6. Sabatini, C. (2013). Effect of phosphoric acid etching on the shear bond strength of two self-etch adhesives. *Journal of Applied Oral Science*, *21*(1), 56-62.
7. Legler, L. R., Retief, D. H., & Bradley, E. L. (1990). Effects of phosphoric acid concentration and etch duration on enamel depth of etch: an in vitro study. *American Journal of Orthodontics and Dentofacial Orthopedics*, *98*(2), 154-160.
8. Lopes, G. C., Thys, D. G., Klaus, P., Oliveira, G. M., & Widmer, N. (2007). Enamel acid etching: a review. *Compendium of continuing education in dentistry (Jamesburg, NJ: 1995)*, *28*(1), 18-24.
9. Gateva, N., Gusyiska, A., Stanimirov, P., Kabaktchieva, R., & Raichev, I. (2016). Effect Of Etching Time And Acid Concentration On Micromorphological Changes In Dentin Of Both Dentitions. *Journal of IMAB–Annual Proceeding Scientific Papers*, *22*(2), 1099-1110.
10. Sinhoreti, M. A. C., Consani, S., & Da Silva, M. A. (1998). Morphological effect of the type, concentration and etching time of acid solutions on enamel and dentin surfaces. *Braz Dent J*, *9*(1), 3-10.
11. Jia, W., & Jin, S. (2003). *U.S. Patent No. 6,537,563*. Washington, DC: U.S. Patent and Trademark Office.
12. Mar. 25, 2003. The United States Pharmacopeia Convention. (2011); page 3 http://www.usp.org/sites/default/files/usp_pdf/EN/USPNF/2011-02-25711DISSOLUTION.pdf
13. Lee, C. T., & Chang, K. Y. (2012). *U.S. Patent Application No. 12/976,264*.