

Etching Gels

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Original Research Article

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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 mass 1

kg. After 10 second diameter of the circle was measured 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

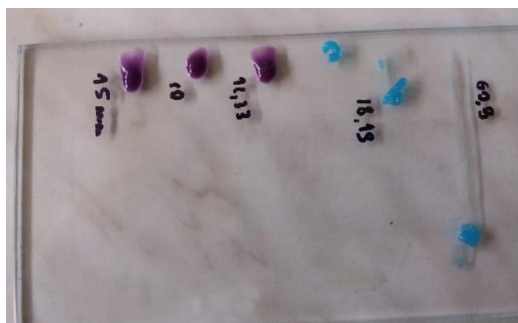


Fig-2: Samples after 10 second of vibration

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].

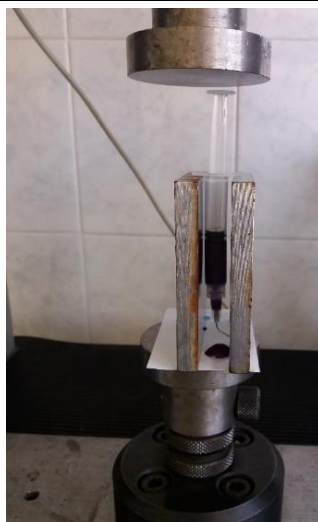


Fig-3: Extrusion force measurement in Shimadzu compressive strength instrument

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 possible to observe difference in diameter of materials used for gel 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

DISCUSSION

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 laboratory 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 clinical application. Such test was proposed in US 6,537,563 B2 [11]. This invention describes to use different nanosilica for etching gel. Authors performed a consistency test for two kinds of nano silica and 3 commercial gels (Vivadent Totla Etch, Jeneric Penron and Bisco). Disc diameter made from gel were from 30-50 mm. Which is similar to results from current investigation.

In the same source is possible to find information about film thickness. The commercial gels have this parameter from 6-8 μm. These two gels tested in this work have the same value.

Other important parameter which is closely connected with consistency is thixotropy. Materials which can form 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. Thixotropy tests under vibration table performed in this work clearly show that gel on the basis of fumed silica is flowing more [2, 4, 9, 10].

US 2012/01 61067 A1 describes to use carboxy methyl cellulose as a gelling agent in etching gels. In their work they performed 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 show that Kerr material has lower extrusion force and Spofa material has higher. But both of them are used by practitioners for many years. It means that values described in patent can be used only as a guide.

Gel disintegration test was followed by US 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 disintegration time. From the clinical point of view it can be an advantage 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 clinicians prefer material with higher viscosity for some application, other groups of practicing doctors are using less viscous materials

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CONFLICT OF INTEREST: None

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