

COMPARATIVE BIOMORPHOLOGIC ANALYSIS ABOUT THREE DENTINAL ADHESIVES OF LAST GENERATIONS

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ABSTRACT

The aim of this work consists in a comparative biomorphological analysis of the properties of infiltration and of adhesion to dental tissues of three among the more used enamel dentinal adhesives of the last generation known with the commercial name of Syntac, Excite and Prompt.

The results have given evidence that Syntac has got short adhesion, Excite has got good capacity of infiltration and moderate adhesion, Prompt seems to possess a capacity of infiltration equal to Excite's one, but a better adhesion besides an easier modality of use.

RESUME

Dans ce travail on a réalisé une analyse biomorphologique comparative des propriétés d'infiltration et d'adhésion aux tissus dentaires de trois adhésives émail-dentinelles, parmi les plus employées par les dernières générations. Ces adhésives sont bien connus avec les noms commerciaux de "Syntac", "Excite" et "Prompt".

Les résultats ont mis en évidence que le Syntac présente une faible adhésivité; l'Excite montre une bonne capacité d'infiltration et une discrète adhésivité; le Prompt semble avoir une capacité d'infiltration aussi bonne que celle de l'Excite, mais avec une adhésivité de loin meilleure et un plus facile mode d'emploi

INTRODUCTION

The strong trend registered during the last decades in restorative dentistry to use the "composites" as an alternative to the traditional amalgam to obtain better aesthetic and functional results, has raised the need to obtain materials with adhesive properties (Eick J.D. et al. 1997) such as to guarantee a good adhesion of the "composites" to dental surfaces to restore.

So "dentinal adhesives" were born and during the last years (Mercuri M. et al. 2001) have obtained good improvements in their adhesive capacities.

While, in fact, the first adhesives were made by substances that formed simple but weak chemical link (as in the case of the cyanoacrylates that chelated with the calcium of hydroxyapatite or of the isocyanates or of the phosphate esters that formed some links with the collagens) these more recent ones are characteristics because of their capacity to form not only micro mechanical links but also chemical ones (Nakabayashi N.

et al. 1991; Rapisarda E. et al. 1999; Schpbac P. et al. 1997).

This was made possible thanks to the combined use of pre-treatment of dental tissues (etching) and the subsequent application of suitable solvents to support the penetration of the adhesives in dentinal tubules.

Little variations either of the application time of the etching gels or of their nature, or of nature and application either of the application time of the solvent have, further on, contributed to improve the potentiality of these adhesives and distinguish among them numerous models with various astonishing properties not always recognized by all the researchers.

This brought us to the decision to make our own personal opinion on these arguments by doing a comparative biomorphologic analysis on three among the most recent and diffuse dentinal adhesives: Syntac (V^o generation), Excite (V^o generation) and Prompt (VI^o generation) (Vargas M.A. et al 1997; Burke F.J. et al. 1996).

MATERIAL AND METHODS

We have utilised 30 dental elements (superior and inferior premolars) extracted for orthodontic reasons. In these elements it was created a cavity 4 mm deep and 5 mm large with a cutter Intensiv n 219.

- The first ten teeth were treated with a dentinal adhesive of V generation according to some authors, of IV according to others, but certainly of last but one generation, Syntac Single-Component (by Ivoclar-Vivadent). The cavity was treated with 37% orthophosphoric acid then with the dentinal adhesive Syntac formed by HEMA, MMPAA, maleic acid which partially dissolves the inorganic parts of enamel and dentin.

- Other ten teeth were treated with an adhesive of V advanced generation, Excite (by Ivoclar-Vivadent). This adhesive contains Hema, dimetacrylates, acrylate fosfonic acid, highly scattered silicate bioxide and a solvent like ethanol that makes it more suitable in humid dentin. The cavity was treated according to the manufacturer instructions: orthophosphoric acid 37% on the enamel for 15" and then on the dentin for 10"; after the washing, the dentin was left humid and Excite applied on ten dental elements rubbing it for 10" and then light cured.

- Other ten elements were treated with monocomponent adhesive Prompt (by ESPE). The cavity was prepared following the instruction of the repair technique and it was lightly dried, but kept humid. Prompt was applied (without previously etching the cavity), rubbing it for about 15", drying and forming an uniform patina over the cavity.*

*The characteristics of an auto conditioned adhesive such as the Prompt L-POP made of orthophosphoric ester in aqueous solution (a by-product of the methacrilphosphoric acid plus H₂O), is that the aqueous solution only attacks the superficial enamel and dentin. On the enamel, thanks to the ph, there is a conditioning like the one made by phosphoric acid; this allows the formation of a grid for the micro mechanic fixing material of the filling materials. Other characteristics of the product is that the primer does not need any rinsing and can be dried with a jet of air

In both the cases the cavities were filled by using a fine particles hybrid material, like Tetric Ceram – Vivadent, and then refined and polished with silicone Shofu points. The dental surface not involved in the reconstruction was isolated by a coat of transparent paint and then the samples dipped for 12 hours in a 1% solution of methylene blue and dissected according to an axial plane.

Then the so obtained sections were dipped into methylene blue for 12 hours, after enamel painting of the

side around the restoration, and the obtained samples analysed by stereomicroscope and SEM (Szekely et al. 1999) to see possible marginal gaps and the behaviour of the resin towards enamel and dentine in the dental elements treated with the three different adhesives. The samples were observed with SEM Laica Stereoscan 420 with a voltage of acceleration like 15 kV.

RESULTS

The observations by stereomicroscope have pointed out no infiltrations of methylene blue in all tested adhesives. From the analyses by SEM we deduce that in the cases treated with Syntac there is a retraction during the polymerisation which can often cause the fracture of the resin plugs and/or the emptying of the dentinal tubules. (Fig. 1-2)

The observation by SEM of the cases treated with Excite points out the presence of a lot of plugs inside the dentinal tubules; the plugs penetrate into the tubule for a length of 30-50 micron and with high enlargement we notice that sometime some of them are not adherent to the surface of the tubule. (Fig. 3-5)

Sometimes we see some micro gaps of little dimension. (Fig. 6)

The observations carried out with Prompt L-POP monocomponent have pointed out no gaps, good penetration of the resin in the dentinal tubule for a depth equal to cases treated with Excite and then that the resinous plugs adhere perfectly to the surface of the tubule. Sometimes the resinous plugs have shown linear fracture along its axis (Fig. 7)

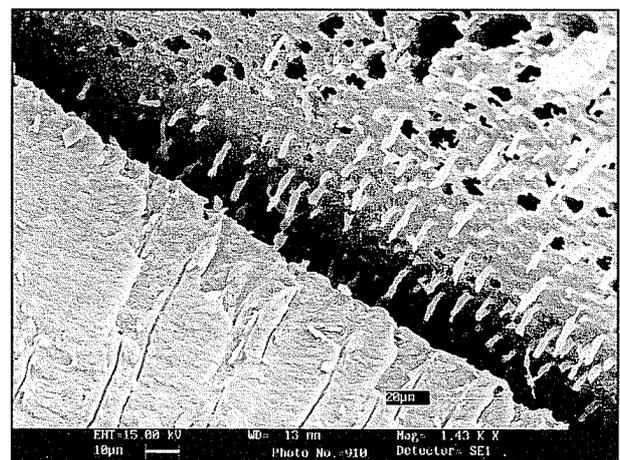


Fig. 1. Compound treated with Syntac. On the right side composite with resin plugs; on the left side, dentin. To note the large retraction of the plugs by dentinal tubules in the composite dentin interface.

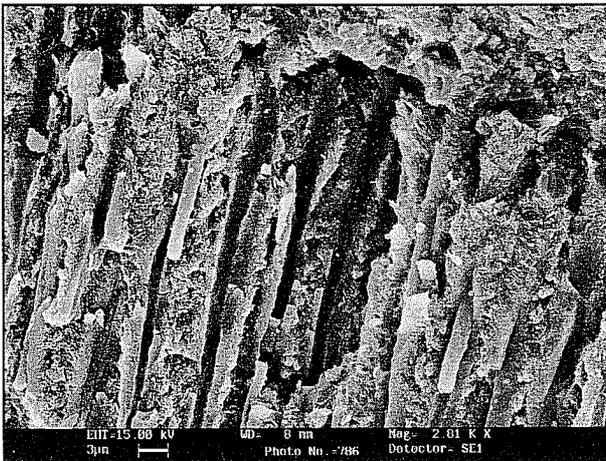


Fig. 2. Other compound treated with Syntac. A lot of dentinal tubules are vacant.

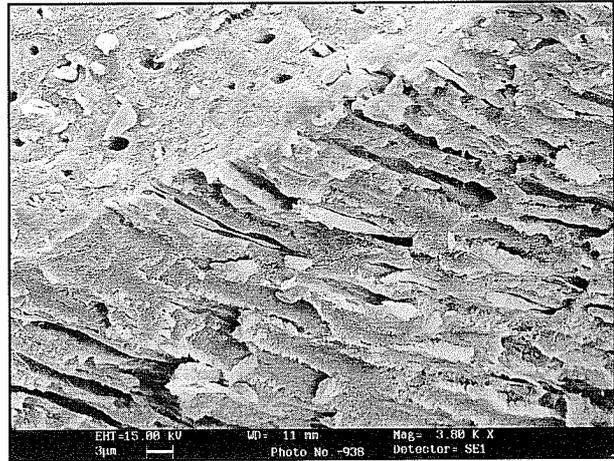


Fig. 3. Particular of a compound treated with Excite. A lot of dentinal tubules are filled by resinous plugs

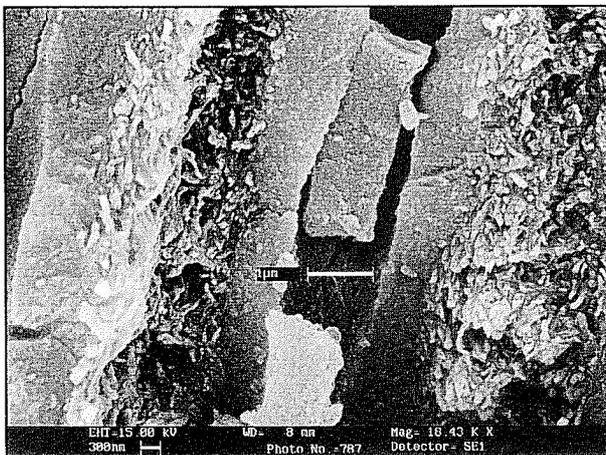


Fig. 4. Particular of the previous picture showing one resinous plug not closely adherent to the surface of the tubule

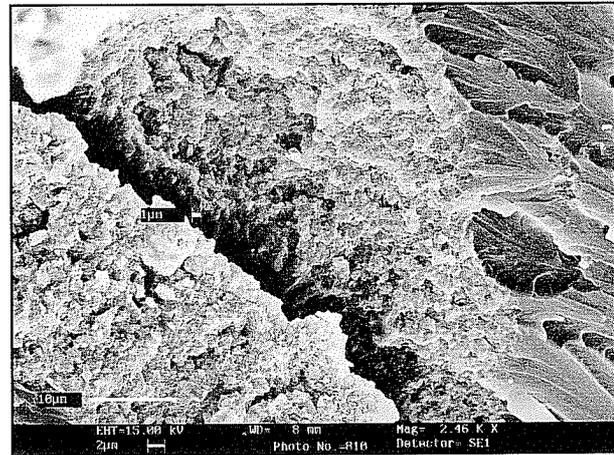


Fig. 5. Another compound treated with Excite; a micro gap 0,1-0,2 μ large is present between enamel and composite



Fig. 6. Compound treated with Prompt. The resinous plugs is adhered to the surface of the tubule, but shows a linear fracture along its axis.

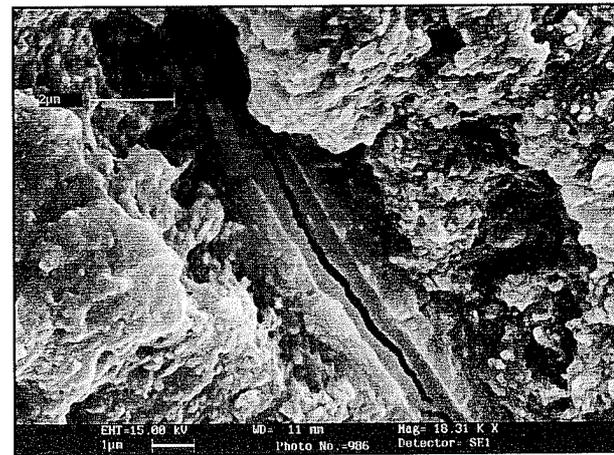


Fig. 7. Particular of the precedent picture where we see that the fracture does not regard the initial tract of the plugs.

DISCUSSION

In the examined cases it has come out that the treatment with Syntac reveals a valid penetration of the resinous plugs in the dentin, but often the resinous plugs fracture after polymerisation and detach themselves from dentinal interface.

The treatment with Excite causes a good penetration of the resinous plugs in the dentinal tubules, the plugs penetrate 30-50 micron of depth and show a separation from the surface of the tubules following up the retraction consequent upon the curing of the resin.

The treatment with Prompt, besides a good penetration in the dentine superimposable to the one of Excite, shows a such valid adhesion of the plugs to the surface of the dentinal tubules as to overcome the intrinsic strengths of cohesion of the resin, in fact in a lot of cases the plugs show fine axial fracture unable anyway to prejudice the closing of the tubules.

These observation lead us to conclude that among the three analysed dentinal adhesives the Prompt shows to have valid capacity of infiltration in dental tissues as well as Excite and rather this capacity of infiltration is superior to Syntac; moreover have a greatest adhesion and then a best closing of the tubules and this make foreseen a long length in the time and also a more simple and more rapid modality of use.

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